The Worshipful Company of Engineers

(Incorporated by Royal Charter 2004)

The Swordsman Newsletter

Issue 23, January 2010

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Top Right	The Millennium Monument in Heroes' Square, Budapest .
Centre	The Out of Towners at Danube Bend.
Bottom Left	Assistants Barry Brooks, David Johnson and Clive Walker in the Lord Mayor's Procession.
Bottom Right	The Aquatics Centre at the Olympic Park.

FUTURE EVENTS

2nd March 2010	Election Court Meeting and Service	Wax Chandlers' Hall
19th March 2010	United Guilds' Service	St Paul's Cathedral
20th April 2010	Common Hall and Installation Dinner	Fishmongers' Hall
11th May 2010	356th Festival of the Sons of the Clergy	St Pauls' Cathedral
24th June 2010	Election of the Sheriffs	Guildhall
6th July 2010	Awards Dinner	Gibson Hall
25th-26th July 2010	Annual Golf Competition	Welcombe Club Stratford
24th-26th September 2010	Out Of Town Meeting	East Yorkshire
28th September 2010	Election of Lord Mayor	Guildhall

EDITORIAL

Once again a bumper edition of the Swordsman. The improved presentation of the last edition received many commendations not least from the Editor. Swordsman 22, like this one, was printed by a Professional Company rather than in house and came out cheaper as well as reducing the pressures on the Office.

Many thanks to all the reporters who have prepared articles on the Company's activities over the last few months. The different styles of the reports provide greater interest and variety to the Swordsman than would otherwise be the case. This time there are some real gems amongst the reports and I commend them all to you.

The Contribution from Jeff Temple on Climate Change in the last edition provoked much discussion with positive comment and scepticism in equal measures. We discussed in Court if the publication of such papers was appropriate for a Members' Magazine and their guidance was that if papers were offered, which had not been published elsewhere then they could be considered for the Swordsman. This edition contains the Junior Warden's lecture, 'If Stones Could Speak' which was given at Watermens' Hall and well received as well as a résumé of the paper presented for the Hawley Environmental Award. The Charitable Trust has also recently started supporting Secondary Education and a report on our Arkwright Scholars is also included. Avid readers of the Swordsman will know that the support given by the Charitable Trust to the Ironbridge Gorge Museum has enabled the Museum to name an Engine to run on the new narrow gauge mine railway at Blists Hill in honour of our Founder Master Sir Peter Gadsden. Past Master Bryan Gibson who is the Company's representative Trustee on the Ironbridge Development Trust attended the actual naming of the Engine on 7th October.

Past Master Bryan Gibson with Mary and Professor Alan Gillett (Chairman of the London Branch of the Development Trust in succession to Sir Peter Gadsden) with his wife Patricia

In an Article in the St Paul's Cathedral Magazine 'Epistle' Martin Stancliffe, the Surveyor reported that the ten year Tercentenary Project to repair the Cathedral had been selected as the RICS Project of the Year for 2009. He went on to thank all the Cathedral's many supporters which includes the Company and once again shows the good use to which the Charitable Trust is put.

Raymond Cousins

Email cyril.blumfield@btinternet.com.

THE MASTER'S COLUMN

The end of 2009 marks a point two-thirds of the way through my year as Master, with almost all our Company's major events already happy memories. February will see our Bridge Lecture at City University, given by Liveryman Doug Oakervee on the subject of Crossrail, allowing us to show business leaders in the City one way in which they benefit from Engineering, and why they must support investment in UK infrastructure renewal. In our Court, we have to consider my Strategy Review, and conduct important election business, early in 2010, as well as helping our long-standing Beadle and Assistant Clerk Stephen Grundy get our new Clerk, Tony Willenbruch, up to speed.

This edition of Swordsman reports Company events which seem to have been greatly enjoyed by members. Sylvia and I thank the many members who have come to them, and brought guests. I feared that the financial turmoil, and the threat of swine flu, might mean that attendances would be reduced, but if anything, numbers are up. I hope the reports convey the warmth and friendship that characterise our events and that more members will join the many who seize on each new company events mailing and book early, to avoid disappointment.

Of the many events that I have represented the Company at, I would like to mention two that were in the first half of November. On a bright sunny Monday, Masters gathered at St Paul's and with the Royal British Legion and the outgoing Lord Mayor, Ian Luder, we created the City's garden of remembrance on a lawn to the north west of the cathedral, with poppies and crosses bearing the names of all the Livery Companies. With military music competing with the noise of traffic and builders, it was a delightful moment of reflection, not only on previous conflicts, but on the bravery and sacrifices of our forces today. Not a fortnight later, on a gloomy Saturday, I and three Court Assistants joined the Modern Liveries float in the procession of the new Lord Mayor's Show. The heaviest of the rain held off for most of our outward leg past Guildhall, Mansion House, St Paul's and the Royal Courts of Justice, but after our sandwiches aboard HQS Wellington (the permanently moored ship which is Livery Hall of

Worshipful Company of Master Mariners) it was plastic ponchos over our gowns, and an umbrella protecting the Company's new Tudor Bonnet that I was giving its first outing, as we paraded back through the downpour. No matter how bad the weather, it has never caused the cancellation of the Lord Mayor's Show. Indeed, the only time it was cancelled was in 1852, for the funeral of the Duke of Wellington. Substantial crowds braved the weather this year, lining the route back to Mansion House, and how nice it was to hear people in the crowd say "Good to see you Engineers" when they saw our banner, and to reply "Good to see you too".

As well as events like these, your Master has the pleasure of attending functions of other Livery Companies. He is also invited to personally support other charity events. So it was that Sylvia and I attended a thoroughly memorable programme of Christmas music at Glaziers Hall performed by pupils of Treloar School, founded in 1906 by Lord Mayor Sir William Treloar. The boys and girls of the school are all severely disabled, indeed 20 of the 22 in the performance were in wheelchairs and some of these had speech and other disabilities too. In this "Treloar's Christmas of Light 2009", they were supported by members of the National Youth Orchestra who had spent a week at the school in the summer helping the pupils with music. Some members of the choir of Frensham Heights School, who also support Treloars through the year, joined in for part of the performance. There were several very touching moments when triumphs over adversity were very evident, and a magical performance by the members of the NYO of a short piece composed by one of the Treloars girls. It was wonderful to be able to be involved with many people in the City who support these children and their carers and teachers.

It won't surprise you to hear that I am looking forward to everything that the remaining third of my period of office as your Master brings.

Chris Price

THE HONORARY CLERK AND HIS LADY'S FAREWELL

Margaret and I have been overwhelmed by the wonderful show of thanks for my service to you all as your Clerk. So many of you responded to the (unknown to me!) invitation to recognize my 7 years in office that I hope that you will all accept this note as our formal reply in gratitude.

As I said on the Dixie Queen in response to The Master's generous words about our efforts – the time

has flown and it just did not feel like work. In fact, in line with the late Founder Master Sir Peter Gadsden's wise advice to The Company, it certainly has been fun to have been so closely associated with the Livery from the perspective of the Engineers' Office. Although I was a liveryman already, the learning curve was a steep one for a new Engineers' Clerk in first-time accommodation within Wax Chandler's Hall and I thank those who gave me such useful help and guidance to avoid most of the pitfalls – my especial thanks to my Assistant and our Beadle, Stephen Grundy, whose dubious 'reward' for his unstinting support to me is to train up my successor! Though, I am sure that Wing Commander Tony Willenbruch, who is well-qualified for the appointment, will have as good a time as I did as Clerk.

Our farewell gift of the Martyn Pugh designed silver-topped glass wine jug engraved with 'The Ironbridge' and the motto from the Company's badge was stunning as was the designer necklace for Margaret – both obtained, most aptly, through the Goldsmith's Fair. We also thank you for the handsome cheque. However, even more moving were the very many kind letters and good wishes that we received and had been collated into a folder which we will both treasure. It was a great way in which to finish another phase in our lives and we will look forward to meeting with you all again and serving The Company in a different capacity in the future.

Margaret and Graham Skinner

VISIT TO HMS SULTAN
17th September 2009

Members of the Worshipful Company of Engineers made a visit on 17th September to HMS Sultan in Gosport, together with members of the Blacksmiths, Founders, Fuellers, Plumbers, and Turners. The Engineers were led by the Immediate Past Master Tony Roche and his wife Jeanette.

We were welcomed by the Commanding Officer, Cdre A R Rymer, RN, who explained that SULTAN occupies about 180 acres, and is the largest technical training establishment in Europe, with around 3000 people on site daily. The establishment covers mechanical, weapons and air systems, as well as leadership training.

Lt Gavin Marshall welcomes the Engineers' Party

Young recruits to the Royal Navy arrive at SULTAN following their initial induction training – 'square bashing'. There is no minimum educational requirement for entry, and most recruits do not have even GCSE's. Their technical training at SULTAN is complemented by tours of duty at sea, and sets them on a career path which leads to promotion to Leading Hand, Petty Officer, and potentially Chief Petty Officer. The training they receive at SULTAN is regularly assessed by OFSTED, and recently received a 'grade 1 – outstanding' marking.

The training is designed to be student friendly, with a mixture of computer assisted learning reinforced by practical hands on work, such as stripping and rebuilding maritime diesel engines.

A highlight of the visit was a tour of a suite of rooms configured like those on board the Navy's newest destroyers, the Daring class T45's. (The first ship, HMS Daring, is undergoing her sea trials, and was berthed across Portsmouth Harbour during our visit.) (*We saw this ship being built in VT Workshops during our visit there in September 2007 Ed*). The control room consisted of a handful of positions equipped with large flat screen displays, from which the ship and her various systems are controlled electronically.

In a related T45 classroom, we saw about 20 desks for students, each with a PC linked to a fibre optic network, and to digital control circuits to operate a number of sensors, pumps and valves electronically. Water was pumped between several small demonstration tanks, accompanied by gurgling sounds, just to show that it all worked! This was an impressive use of modern technology, and highlighted the fact that our latest destroyers are highly automated ships, with considerable redundancy built in.

The Engineers' Party about to take off in a Harrier

HMS SULTAN is a key part of the Defence Training Rationalisation Programme, which plans to relocate and centralise all defence training at St Athan in South Wales. This is a huge PFI programme, affecting 19 current sites for technical training across the Army, Navy and Air Force, and which on current plans would see SULTAN move to St Athan in 2014/15. Clearly this will be an enormous challenge for the Commanding Officer and his team.

Our visit was most enjoyable and informative, and our thanks go to Cdre Rymer and his staff, particularly Lt Emma Bakewell for organising the visit, and Lt Gavin Marshall, who accompanied the Engineers.

Alan Grant

VISIT TO BUDAPEST
24 – 27 September 2009

Some seven years after our last Out of Town visit to foreign parts the Master, Chris Price, and Sylvia took us to Budapest, the capital of Hungary where Sylvia was born.

Sylvia's mother, who was English, had gone to Budapest, 'The Paris of the East' as a young lady in the late 1930s. Unfortunately, Sylvia's mother did not receive the telegram sent to her by her own mother saying that the outbreak of War was imminent and so spent some years in Hungary. Sylvia's father was killed during the war but, when Sylvia was four, she and her mother managed to escape from Hungary, where the Communists were in power and the regime was oppressive, back to England.

Of the 83 members and guests who came on the visit just over half enjoyed the full package and flew together from Heathrow whilst the others made their own travel arrangements including one couple who drove the whole 1100 miles each way! Many extended their holidays at the beginning, the end or both to see more of Budapest and other parts of the country.

The Danubius Health Spa resort, Margitsziget

For those of us who flew together to and from Heathrow the flights were as smooth and uneventful as modern flying can be. From the time we arrived at Terminal 5 at 07:00am on Thursday we were debating the excellent engineering of the building and the baggage handling of which only a little could be seen. No bags lost and they were on the carousel by the time we had spent a short time clearing immigration on the way back. We should extol great engineering rather than, as the papers always seem to do, highlighting what might have gone wrong during the construction or on opening.

The reports of the varied and interesting activities follow and I am grateful to all my hardworking reporters for their contributions including those who volunteered extra articles.

Our thanks go to The Master, Chris Price, and Sylvia, the Clerk, Graham Skinner, and his indefatigable wife, Margaret, who is always at the front when things need to be done. On this occasion our thanks also go to the Tour Company and their excellent guides in Budapest.

Raymond Cousins

Arrival and Welcome Dinner

Many members and partners assembled at Heathrow early on Thursday morning for the communal flight to Budapest. The Worshipful Company of Engineers were especially welcomed on board the plane by the Pilot. When we arrived in Budapest we were met by Barbara, one of our Hungarian guides, who gave us a commentary on the landmarks on the way to the hotel, including the history of most of the Danube bridges (nine in all, the oldest being British designed and built).

Széchenyi Chain Bridge designed by William Clark and built by Adam Clark

The Master and Clerk, assisted by Sylvia who was born in Budapest, had chosen a hotel on Margaret Island (Margitsziget) in the middle of the river. This seemed to indicate that we were in neither Buda nor Pest, although we learned later that the island was part of Pest, which is the larger of the combined cities. The Danubius Health Spa Resort had indoor and outdoor swimming pools, two large thermal pools and comprehensive medical and beauty treatment facilities.

A free afternoon allowed for a variety of activities from sunbathing or swimming in the hotel to walking or jogging around the island, which is a dedicated leisure park in the middle of the city with woodland walks, beautiful gardens and an impressive fountain.

Close to the hotel were the extensive ruins of a Dominican Convent and Church, dating from the 13th century. It was the home of St Margaret (1242 to 1271), the daughter of King Bela IV who, having lost two elder daughters, promised her to the church if she survived. Her grave is still kept as a shrine.

Flight Coupon Raffle Tickets

The Welcome Dinner that evening made us think hard as we were faced with two competitions and a raffle to raise money for charity, particularly RedR. Thanks are due to Richard and Janet Groome who provided a list of airport names and abbreviation codes to be recognised and a book of flight tickets to be purchased for the raffle. The table challenge this year was to speak about famous Hungarian scientists and engineers.

Master Chris Price gave a brief but informative history of Budapest, which houses almost 20% of the 10 million Hungarians living in the country. Another 5 million live elsewhere, mostly in surrounding countries due to border changes following wars, "A country surrounded by itself." Budapest was enlarged under communism in the 1950s but Hungary later played its part in bringing down the Iron Curtain by welcoming East German tourists and taking them to see the Austrian border, which was uncontrolled. The coaches usually returned empty!! Chris also gave us the true facts regarding many of the famous Hungarians we had struggled with at the dinner tables.

Finally, Honorary Clerk Graham Skinner, in his swan-song outside broadcast, briefed us on the programme for the week-end and introduced his successor, Tony Willenbruch, who will be installed in January 2010. All-in-all a very enjoyable first day. And so to bed – or, for some, to the bar.

Ken Hambleton.

Visit to Budapest University of Technology

Our party of 39 engineers was greeted by Mr László Dvorszki, the Director of International Affairs at the Budapest University of Technology and Economics (BUTE). As we mounted the steps to the building, he pointed out four new statues fronting the building and representing Civil and Mechanical Engineering, Architecture and Economics. Immediately inside the building, he showed us a memorial to the nine students of the University who had been killed in the 1956 uprising.

The Four Statues outside BUTE

After coffee, we were given a briefing which was chaired by Dr János Ginsztler, the President of the Hungarian Academy of Engineering. After welcoming us, he introduced Professor Gábor Péceli, the Rector of the University.

The Rector then gave us a brief introduction to the University and to BUTE. The University was founded in 1782 when it was the first institution in Europe to train engineers at university level. After several changes of name and integration with other institutions, BUTE was formally constituted as it is now in 2000. The Rector then told us with justifiable pride that three former students had become Nobel Laureates – Jenö Wigner (in 1963 for nuclear physics), Dénes Gabor (in 1971 for holography) and György Oláh (in 1994 for hydrocarbon chemistry). He also mentioned six other students who had become world-famous including von Kármán, Szilárd and Teller. The Rector continued with an outline of BUTE as it is

today. BUTE has 8 faculties, 22,000 students and 1,300 academic staff. Teaching is in both Hungarian and English. It has an annual budget of €104M of which 26% is devoted to R&D and Innovation. The University has research and student-exchange relationships with 17 British Universities and many others worldwide. At the conclusion of the Rector's briefing, the Master rose to thank him for hosting our visit. After remarking that the University amazingly taught engineering in Latin in the early days, he presented the Rector with a copy of Past Master Bryan Gibson's History of the Company.

Diana Blair-Fish presenting the Portrait of her Father, Sir Denis Rooke, to Dr János Ginsztler, President of Hungarian Academy of Engineering

We then had a very pleasant interlude when Dr Diana Blair-Fish, the daughter of the late Sir Denis Rooke, gave a short speech, at the end of which she presented the President with an excellent charcoal portrait of her father. The President was pleased to

accept the portrait by June Mendoza on behalf of his Academy and told us that Sir Denis had visited Budapest in the late 1980s to give advice on the formation of the Hungarian Academy of Engineering. Following Sir Denis's advice, the Academy was successfully founded in 1990 and now has 201 Fellows and 40 Foreign Members. He then presented Diana with a copy of the current Register of Fellows.

After this ceremony we received detailed presentations on the research being undertaken by the engineering departments, much of which is being conducted in collaboration with other universities and companies around the world.

The End of the Degree Awards

After the Master had thanked the President and the academic staff for their welcome and very interesting briefings, we took our leave. As we walked out from the building, we were pleasantly surprised to witness the final few minutes of a degree-awarding ceremony in the main hall.

Roger Voles

Partners Visit to Buda Castle

On the first visit of our trip to Hungary our charming Guide – Barbara joined us at our Hotel, we boarded our coach and travelled down the east bank of the River Danube to the Széchenyi Chain Bridge. Passing the imposing statuesque lions guarding the entry and exits to the Bridge we passed over, and then up the hill to Buda Castle. We left our coach and walked up the steep incline to Szentharomsag Square (Holy Trinity Square) in front of the imposing St Matthias Church also known as the Coronation Church. As we gathered around our Guide she calmly said that the old fortified Castle does not exist today, we were stood where it used to be, on Castle Hill.

Originally built in 1265, the Castle flourished until the Turkish Invasion in 1541 when it was left to decay. It was destroyed in 1686 when the Turks were driven out of Hungary. The Habsburgs rebuilt it in the mid 1750's, it was destroyed and rebuilt twice more before the Allied Forces destroyed it finally in 1945 when they were rooting out the last remnants of the German Armed Forces at the end of the Second World War.

Today the former Royal Palace still remains as a cultural centre containing three museums and it is also the home of the National Szechenyi Library. Some of the original fortifications have been reconstructed on

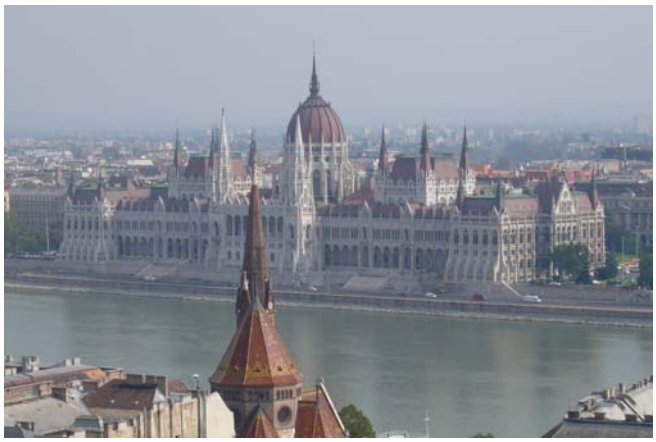
their medieval foundations and are known as Fishermans Bastion. This fortification provides some of the most spectacular views of the City, across the river to the Parliament Buildings and views along the river in both directions.

Fishermans Bastion

Barbara showed us the Column erected to commemorate the large number of the City's population who had succumbed during the time of the Black Death (1351). We then moved on to St Matthias Church on the other side of the square. This Church has survived the many catastrophes which finally destroyed the Castle, and it has been rebuilt many times.

St Matthias Church

The Church itself was truly amazing, virtually the whole of the interior is covered with bright and colourful paintings, many in painted tapestry form. Barbara told us that this work was completed at the end of the 19th Century, and is based upon fragments of the ancient Hungarian floral designs found among the debris when rebuilding was being carried out. We continued around the Church before leaving to explore the surrounding area.



The Parliament Building from Castle Hill

Castle Hill is about one mile long and a third of a mile wide. The old castle district outside the main castle area is where the ancient town of Buda developed. Today it still has its layout of medieval streets and some of the houses date back nearly three hundred years.

We wandered around these old streets among its cafe's and coffee shops, stopping to sample the fine coffee and cakes on offer. This was an excellent visit in bright sunshine in a truly fascinating and clearly ancient part of the City.

Janet Williams

Tour of Pest

Raymond made a big mistake by asking me to write up the tour of Central Pest. I'm never at my best in mid-afternoon, even less so following an intensive morning session, a particularly good lunch and the race to change into best togs demanded for the forthcoming opera trip. Half asleep as we left Margaret Island and resting my eyes for long periods thereafter, I really only regained consciousness when we were compulsorily debussed in Heroes' Square. To cap it all, such notes as I took proving to be mostly illegible, some of what is being reported here had to be sourced from a Sunday morning trip in which Gillian and I joined up with the Master and Sylvia, using (free) public transport to go to pedestrianised Vorosmarty Ter and watch Budapest society go by before walking across the Chain Bridge to the Buda funicular.

Portico of the Museum of Fine Arts

Those wider awake than me heard the ladies' perfect score and no passes response to the searching test Christina, our coach's guide, gave them on her morning briefing on Hungary's turbulent history. For example, that its rulers - honourably excepting King Stephen (who as I now know, twenty-five years after baffling my hosts with a reference to Professor Tobias on an earlier visit to Budapest is spelt Istvan and pronounced quite differently from our way) consistently chose the wrong side and consequently lost out successively to the Romans, Huns, Magyars, Mongols, Turks, Habsburgs, Nazis and Russians. Against that background, it is entirely understandable that they imported a totally impenetrable language from a far-off, supposedly neutral country.

The Millennium Memorial in Heroes' Square

Though much of Pest was destroyed, we saw plenty of sympathetic reconstruction, with a fair number of handsome 18th Century Baroque and neo-classical buildings surviving. For my money, though, the much-vaunted neo-gothic Parliament Building is derivative, principally distinguished by being the largest of its kind in Europe. Better inside, perhaps? In Heroes' Square, we gazed at Vajdahunyad Castle and the Millennium Monument, heard an implausible explanation as to why the heroes wore Viking helmets and were moved at the reminder that the 1956 Spring uprising failed because the French and British were more interested in retaking Suez. We were told that you can tell whether heroes died in battle or in bed from the front left hoof of the horses they were mounted on being on or off the ground, but I cannot now recall which was which. We peered at the Zoo's famous elephant house as we passed by in congestion reminiscent of home, saw entrances to the city's pioneering underground railway, learnt that the huge City Park is full of springs and were pointed, rather *sotto voce*, at the House of Terror Museum on Andrassy 60, the reconstructed monument to the victims of the place where so many Hungarians were imprisoned, tortured and killed by Nazi and Communist political police. Finally, having lost no-one en route, we sought refuge and refreshment in the State Opera House, where a more wide-awake Doug Oakervee took over reporting responsibility.

Ian Nussey

Tour of the Opera House

Unlike the enthusiastic crowd that attended the opening of this magnificent building on the 27th September 1884, the police were not called to restrain our party although we were equally overawed by the elegance of the Hungarian State Opera House when we visited it just two days prior to its 125th Anniversary. Both the neo-Renaissance architecture and the decoration follow a far reaching, unified programme that seeks to express the power and universality of music, manifested in many guises in and outside the Building. The Opera House which took 9 years to construct is situated on Andrássy Avenue is guarded by two sphinxes either side of the main entrance and above the splendour of the façade a parapet with statues of famous composers.

The Ceiling of the Foyer

We learnt from enthusiastic young lady guides that the building was the product of a competition won by the

renowned Hungarian architect of that period, Miklos Ybi. The Emperor Francis Joseph of Austria and King of Hungary reluctantly provided half the capital cost of the project to appease the nobles of Budapest who complained bitterly that their nearest Opera House was in Vienna and the balance of the monies was met by the relatively newly founded City of Budapest. The Emperor dictated that the building should be smaller and not surpass his beloved Vienna Opera House, whereas, the City demanded it be more beautiful; contradictory instructions from the client body, little changes with the passage of time.

The Auditorium Chandelier

The Emperor attended the opening of the Opera House and was furious because although smaller it was considered more beautiful than his Vienna Opera House. Here all that glittered was gold and in recent years has been restored to its full beauty as we saw. The gilt work is all of 24 carat gold with a total of 2.7kg having been beaten into gossamer thin gold leaf. In protest Francis Joseph never returned to the Opera House and as a consequence the Royal Box could not be used again during his reign. On the other hand Queen Elizabeth, better known as Sisi, loved the Opera House and Hungary spending most of her time in Budapest had the Box to the left of the stage and above the press box modified to suit her requirements thus enabling her to attend many operas and ballets with her friends and lover - the prime minister.

There are three principal staircases leading to the auditorium one leading to the Royal Box, another for the nobility which forms the main stairway built and adorned with various marbles and elaborate wall coverings and the third, which we did not climb, was for the commoners leading to the upper circle and lacked the décor of the others.

One became enchanted by the arched ceilings supported on marble columns divided into distinct panels by fine ornate plasterwork, each panel beautifully painted depicting scenes from Greek mythology. The friezes followed in similar form adding to richness of the decoration. As is always the case when lost amidst such beauty it is difficult to find what is outstanding but it must be said that the ceiling of the auditorium surrounding a bronze chandelier approaching 3 tons in weight had to take the prize.

Constantly gazing up at the paintings it was easy to overlook the woollen carpets beneath our feet, unfortunately mostly covered for their protection. There were 100,000 knots per square metre which gave a fine texture making the most of the exquisite pattern that is normally only achieved with silk. The carved timber work and doors and their surrounds were executed with equal precision and skill, in one room alone the two doors and surrounds took a father and son 7 years to carve.

The Red Room adjoining the Royal Box was again a fine example of the workmanship of that time but differed from the others as it had not been restored and was exactly as completed 125 years before. We were told that the reason was that this room was frequently used by Sisi to entertain her guests and lover and upon her death it was sealed and not opened until recently. Age had dulled the richness of the red wall hangings and the carved timber had darkened but none of this detracted from its beauty.

The Master and Sylvia enjoying the Reception

Weary from our lengthy and informative tour we retired to the buffet - a two storey high hall surrounded with wall murals by Arpád Freszil. Here we enjoyed Hungarian style open sandwiches and pastries washed down with champagne and just to give it the feeling of times gone by, a little warm and flat. Some found benches to sit on in the smokers' lobby for this Opera House had smoking restricted to one area from its early days. Apart from smokers in days gone by it was here the lovers took sanctuary not to be spotted through the thick smoky haze. And finally it was here and here alone that the genuine gave way to the fake for the gold in the wall hangings was apparently not real but merely a blend of silver and yellow threads.

A wonderful visit enjoyed by all that would rival the enjoyment of the Opera Manon Lescaut that followed.

Doug Oakervee

A Performance of Manon Lescaut at the "Hungarian State Opera House"

The most excellent buffet, together with a glass of champagne, set the scene for the performance which was to follow, Puccini's Opera, Manon Lescaut, part of the 125 years' Celebration Programme of the Opera House

To review the performance of a four act Opera is not unlike being a food critic of a four course dinner. Tastes can vary enormously so I give you my impression and understanding.

The opening act set in the public square in Amiens, France around 1720 was very well presented with a lively performance by the large chorus in their colourful costumes. Manon arrives, accompanied by her brother, Lescaut, who is escorting her to a convent on the orders of their father. With them on the journey is Geronte, a wealthy Parisian gallant who has become enchanted by Manon. She in turn is approached by and falls for the charms of the local Chevalier Des Grieux who, during their encounter, persuades her to run away with him, evading both the convent and the elderly Geronte. The performances of both Manon, played by Sumegi Eszter, and Des Grieux, played by Kiss B.Atilla, were outstanding but sadly the lesser roles were often somewhat drowned out by the Orchestra.

During the first interval we were once again taken into a very attractive salon and served with the Hungarian Tokay wine.

Act II takes part in the very glamorous and richly furnished Paris apartment of Geronte where Manon now resides, having tired of the poor life offered to her by Des Grieux. Although enjoying the luxurious clothes and jewels showered on her by Geronte, she still has feelings for Des Grieux which she admits to Lescaut during his visit. He sends for Des Grieux and Manon is thrilled by his sudden arrival.

Preparing the Set during our Afternoon Visit

The ensuing passionate love duet was wonderfully performed as they make their plans to run away together. However, Geronte arrives and Manon cruelly mocks him about his age. Geronte leaves but threatens to return. However due to Manon's desire to gather together all her jewels before they leave they are delayed and Geronte returns with the guard. Manon is arrested for theft and taken to prison.

Act III finds Des Grieux and Lescaut outside the prison next to the docks where a ship awaits to deport the prisoners across the sea to America as their punishment. Through the bars of the prison window Des Grieux and Manon declare their undying love. This was again a very fine and moving performance by the principal players. As the prisoners are loaded on to the ship Des Grieux pleads to be allowed to join Manon, even to work as a deckhand. Eventually the Captain agrees. The scenery, including a very large section of the ship, realistically added to the sombre air of sadness.

Act IV. On a vast empty plain on the borders of New Orleans, Manon is exhausted and close to death after their desperate journeying. She pleads for water. Des Grieux searches the horizon for signs of life and after making Manon as comfortable as he can, goes in search of help. Manon gives way to despair and on his return Des Grieux finds her on the brink of death. However, it was not until some 30 minutes later after some very dramatic and sorrowful singing by both Manon and Des Grieux did the end finally come.

I feel that most of our members, if not all, found something to admire in the performance of this Puccini Opera. Everybody, however, cannot have failed to be impressed and enchanted by the Opera House itself.

John Huffell

Visit to Szentendre

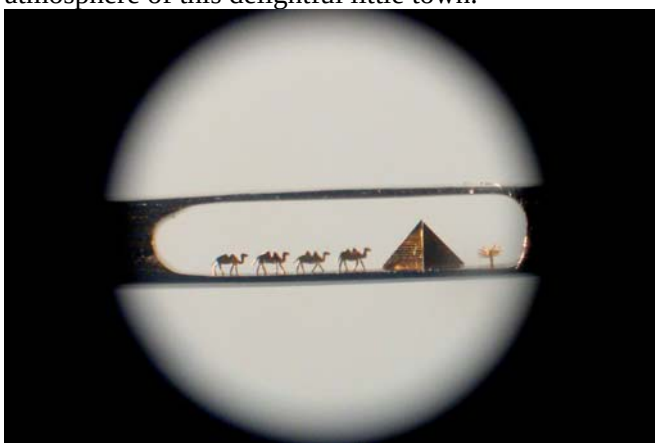
On Saturday we awoke to find a clear blue sky with a prospect of temperatures in the early or mid 20's. Whilst enjoying breakfast we were able to watch many Hungarians running along the special track which circles Margaret Island - some of us were feeling guilty. Everyone was on time for the 09.00 departure of the two large white luxury coaches which we were coming to know well. The first one had the guide, Christina, with driver Zoltan and the second guide, Barbara, with driver Andras.

Entering Szentendre

We drove through the outskirts of Budapest and passed many of the large housing blocks which had been built at various stages after the Second World War. The guides told us much about the history of Hungary and during the journey we passed a section of an aquaduct which had been built by the Romans to take water from the hot springs in Budapest to areas without such benefits. The guides did not mention that we passed a Tesco and an Auchan hypermarket on the journey!

As we neared our destination of Szentendre (Saint Andrew) we saw many detached houses with gardens and we were told that only prosperous Hungarians were able to afford these. We were also reminded that agriculture was the main industry of Hungary and that there were also many vineyards and that Tokay was a speciality. We now know that bottles of Tokay are numbered from 1 to 6 indicating the sweetness of the wine.

After a journey of about 20 kilometres we reached Szentendre and started our short walk along cobbled streets to the centre of this little town which has a Mediterranean feel about it. Many of the houses which were once owned by wealthy merchants have now been converted into museums, restaurants or shops giving a very touristy feeling. Some of us visited the many churches, the museums, enjoyed the shopping or just drank coffee whilst enjoying the atmosphere of this delightful little town.



Camels passing through the Eye of a Needle taken through a microscope in the Micro Museum

We were told many stories by the guides and one remains in my memory. A special wine is produced in Hungary called Somlo and it is often drunk at weddings. Apparently on the wedding night if the bride drinks one bottle she will have a son, if two bottles it will be twins but if three bottles then nothing at all will happen!

Peter Cullimore

Cruise to Danube Bend

A change to the initial programme gave us the opportunity on Saturday to enjoy two cruises on the Danube, one at mid day along the stretch known as the Danube Bend in northern Hungary and the other in the evening in the centre of Budapest.

Christina describes the delights of Danube Bend

In the event we were probably fortunate to be able to cruise at all because after a long summer of low rainfall the river level was so low that some of the long distance cruises had had to be cancelled altogether. This was the case with one of the River Cruises taken by Liverymen after the visit which could not reach its destination.

The Danube is Western Europe's longest river and with the completion of the Rhine-Main-Danube canal provides a continuous waterway for commercial and tourist traffic from either Rotterdam or Basle to Sulina on the Black Sea, a distance of over 2,000 miles. It flows through, or forms part of the borders of, ten countries. It enters Hungary at the town of Visegrad on the Slovak border through a gap in the Carpathian Mountains which diverts its course southwards for the next 300 miles so that it divides Hungary into two almost equal parts.

Typical scenery in the Danube Bend

Water levels in the Danube can be very variable. An extreme flood in 1838 flooded much of central Budapest and again in 1956, 1965, 1991 and 2002. After which the river banks were built up by an extra 8m., a precaution which was necessary and just in time because the next major flood in 2006 came within half a metre of the top of the new banks

After a morning sightseeing in Szentendre we joined the boat MV Szabadi at Visegrad and fortified with a glass of Palinka (a plum brandy) cruised along what is known as the Danube Bend for about an hour.

This stretch is considered to be the most attractive part of the river with wooded slopes on both sides and clusters of private houses hidden in the trees along it. We also had a better view of the 13th.century citadel and castle, once the finest palace in Hungary, on top of the hill behind the town. After the trip we all assembled on the quayside for the group photograph and went off for lunch at the Sunflower restaurant in Dunabogdany and then returned to the hotel.

Robert Freer

The Dinner Cruise

After a short coach journey, we boarded the cruise ship Rákóczi—translated by one liveryman as a 'naughty female Jacuzzi'—in fact, Ferenc Rákóczi (1676-1735) was the Imperial Prince of Transylvania and is considered a national hero (his portrait appears on the 500 Forint notes).

Prince Ferenc Rákóczi featured on a 500 Forint Note

After everybody had been welcomed on board by the Master and Sylvia for the final celebration of the weekend, the ship set off down the Danube and everybody went on to the external decks, drinks in hand, to look at the fairytale floodlit buildings along the river bank. Reluctantly we left the magnificent views and went inside to take our places for dinner with the honoured guests, Professor János Ginsztler, the President of the Hungarian Academy of Engineering, László Magócsi, the Science & Technology Attaché based at the Hungarian Embassy in London and a local resident, Michael Finn, a friend of Denis and Barbara Dickinson.

Richard Groome and Prize winner Mike Howse

From the beginning of the weekend, Richard and Janet Groome worked hard to sell quiz sheets and draw tickets. After an enjoyable dinner, the fun started with the results of the quiz which had required identifying airports and codes. One liveryman (best that he should retain his anonymity) achieved the maximum score,

but admitted the involvement of his Blackberrry, which resulted in the imposition of a fine—which was paid immediately! Dixie Bayley was awarded a small prize for her amusing responses to the quiz. Diana Blair-Fish was eventually declared the winner and was delighted (?) to receive an Airfix Harrier Jump Jet kit.

The first prize in the draw went to Mike Howse (a Champagne reception on Concorde) and railwayman Andrew McNaughton (fittingly) won second prize (two first class rail tickets to Shrewsbury). At this point, Richard became a magician, ensuring that the next ticket drawn was The Master's, Chris Price (who received the board game GO). Then, to confirm his conjuring skills, the next ticket belonged to the Senior Warden, John Robinson—but he insisted that it should be redrawn and Denis Dickinson collected a Box for five at Royal Albert Hall for a Raymond Gubbay Spectacular. Apart from all the fun had by everybody, the special efforts made by Richard and Janet raised £800 for the Company's Charitable Trust which will be passed to RedR charity.

Tour Organiser Katinka and Tour Guide Barbara

After gifts had been presented to the guests, the Master made a short speech and he was followed by John Banyard who, after giving *his* version of the History of Hungary, thanked The Master and Sylvia for organising the out-of-town event. And so to bed at the end of a perfect weekend!

Don Prichard

A Sunday Evening Treat for the Nineteen who stayed an Extra Day

Our first morning in Budapest saw the Group divide - the members to the University and the partners to explore the Castle Hill District of Buda. It was there, whilst in the beautiful St. Matthias Church, that we learnt a performance of Mozart's Requiem was to be given on Sunday evening and admission was free. Most of us who were staying in Budapest, after the official close of the 'Out of Town' Meeting, were keen to go.

Duly, on Sunday afternoon we made our way to Castle Hill, where the gentlemen were given a quick tour of the area by the ladies. A local band played in the park but if you chose to take tea in a Fisherman's Bastion cafe with the most beautiful view overlooking the Danube you were serenaded by a string trio. The Group gathered at the impressive statue of King Stephen and walked to a local restaurant, where, with the good weather, we were able to sit outside and enjoy a variety of Hungarian food and wine.

Inside St Matthias Church

We arrived at St. Matthias Church in good time to ensure we got a seat. Surprisingly, the choir were rehearsing in the church, which they continued to do until performance time. A priest then read for fifteen minutes. With my minimal understanding of the Hungarian language I assumed he was reading from the Bible. Later, I learnt he was giving us an account of Mozart's life! The performance of the Requiem was wonderful. The choir, soloists and orchestra were local people of professional standard, the acoustics excellent and sitting in the magnificent St. Matthias Church to hear this moving work was very special. The Requiem is well known to me. I will always remember hearing a performance in 1991 in St. Paul's Cathedral to commemorate the 200th anniversary of Mozart's death and it was timed to finish exactly at the moment Mozart died (about 01.15).

The Sunday evening performance of the Requiem was an additional treat to the already most enjoyable few days spent in Budapest, which combined interesting activities, excellent weather with great camaraderie.

I always feel very privileged, as does my friend, Jane Forrest, to be invited to participate in your most enjoyable events always in such a friendly atmosphere. Thank you very much.

Ann Gale

VISIT TO THE RENAULT F1 FACTORY 30th September 2009

On a bright Wednesday morning at the end of September, a group including the Junior Warden and five other Liverymen visited the Renault F1 Factory at Enstone in Oxfordshire. The visit had been arranged by one of our new members, Keith Williams, Managing Director of Praxis High Integrity Systems, whose French owner is a technology partner of Renault F1.

Hosted by Luca Mazzocco, the group was given a fascinating briefing on the world of F1 racing and the impressive capability of the Enstone "Factory". A green-field site development, it had a state-of-the-art manufacturing facility for virtually everything but the engine (provided by "Mother Renault") and the tyres. This was complemented by a remarkable development capability including a large-scale wind tunnel, the fifth most powerful computer in the UK and a rolling road on which the group witnessed this year's Car (R29) undergoing a full simulated lap of Japan's Grand Prix circuit and were greatly impressed by the severity of the vehicle's movement.

The group was privileged to be given a very frank briefing on the art, science and politics of the sport by Tad Chapsli, the Technical Director (Chassis), who had stepped-up to accept wider responsibility in the wake of the recent dramatic changes at the top of Renault F1 with the departure of Flavio Briatore following the Singapore Grand Prix crash. The description of the challenge, speed and rate of spend in development was startling, especially as the result is necessarily a very limited production run and often a return to the drawing board at the end of the season.

A case in point was the development of the Kinetic Energy Recovery System (KERS), defined as an FIA requirement in 2007 for the 2009 racing season. The political aim was to be seen to be green by recovering the energy otherwise dissipated thermally during heavy braking. Numerous technologies were rapidly evaluated, including the trusty flywheel, but an electrical solution was eventually chosen. Braking was achieved by engaging a motor/generator positioned between the engine and the driver and delivering the energy in a six second burst to a very capable battery weighing about 30kg. In the accelerating phase, the energy was returned rapidly, with the device acting as a motor and cutting 0.15 to 0.2s from the lap time. Praxis was called in to help with the development, integrity and safety assurance of the chosen solution which was achieved against a very tight timescale.

The first principle of racing car design is to couple a powerful engine with a vehicle that is as light as possible and then to use ballast to optimise the centre of gravity to match the aerodynamic requirements. The inflexible positioning of the weighty KERS unit thus presented a challenge to the whole design team which they met head-on. However, FIA have now moved their emphasis from green credentials to credit crunch, and the new objective is lower cost solutions with the consequence that KERS is no longer a requirement and Renault F1 have ceased to field it. Nonetheless, as with all things in motor racing, there will be wider technology benefit downstream. The team were keen to emphasise their contribution in other areas, including vehicle and aircraft aerodynamics, lightweight structural materials and engine fuel efficiency.

The emphasis on being seen to be green was a little incongruous when considering the practicalities of this global sport. Between each Grand Prix location, Renault F1 move 9 large trucks, 30 tonnes of equipment, 17,000 spare parts, 3 cars, a spare chassis and 90 team members - the combined airbill for the ten teams uses 14 jumbo jets. Nonetheless, the technology and engineering excellence was truly impressive but they were at pains to remind us that the most sophisticated piece of equipment is the man in the 60 to 80°C cockpit, with a heart rate varying between 80

and 220 bpm, who sheds 4kg in sweat. Skill and intensive training are clearly essential, but strangely a key element of their fitness programme is cycling.

Renault F1's investment in excellence was evident in everything the group encountered - not least of all the lunch. We were most grateful to Keith Williams for making the visit possible and delighted to see him clothed the following week at our Court Meeting.

Pat O'Reilly

VISIT TO THE OLYMPIC PARK 20th October 2009

Having watched the development of the Olympic site from the balcony of my daughters flat for nearly three years, and observed the almost continuous activity, it was fascinating to get a perspective from within the site.

The Olympic Stadium

The first impression is of the sheer scale of the undertaking, coupled with the sense of purpose and community that pervades the entire activity. This is as it should be after all the entire undertaking is being planned managed and run by professional engineers of the highest calibre as we witnessed through the excellent presentations we were given.

The Aquatics Centre Roof

I think the technical challenge was best summarised by Howard Shiplee when he stated that on the main Olympic site every type of construction technology is being employed, many of which he had not encountered before. This was borne out by the excellent presentations on different aspects of the undertaking by the senior and specialist engineering staff.

The Steelwork of the Velodrome just started

The first presentation was on the aquatics centre and its daring and simply stunning roof given by Lee Holms (assisted by Nina and John) followed by Liam O'Sullivan's enlightening explanation of the PLUG, the task of digging and fitting out the new electricity grid connection tunnels. The challenge of a demountable stadium came next with an excellent explanation of the complexities of the geometry of the cable tension roof by Paul Hulme. Interestingly while we were in the presentations Boris Johnson and the Mayor of Rio de Janeiro were also visiting the site, and I understand he has agreed to purchase the demountable upper tiers of the stadium for the Rio games. Further presentations by Andrew Weir on the velodrome and Neil Kitchener on the bridge and road infrastructure completed our virtual tour of the site.

Inside the Olympic Stadium with the lighting pods being built

Adjourning to the bus we were treated to an on the ground tour of the site, visiting the major structures. If you ever wanted to know what being in an ants nest is

like, this site comes very close. I have to say the highlight was the roof of the aquatics centre, in the final stages of positioning, and here I would like to thank Nina who accompanied us on the bus. Being the structural steel specialist on the Aquatic roof we were treated to an excellent first hand description in situ by her of the engineering challenge the roof involved.

Our thanks to the staff of the ODA, particularly Bill Frankland who facilitated all the arrangements, and their contractors for looking after us so well were duly given and appreciated and I for one look forward to seeing the site completed.

David Calderwood

LADIES' LUNCHEON
21st October 2009

Firstly what a wonderful venue – Apothecaries' Hall. Originally, built around 1632, then destroyed in the Great Fire of London in 1666, but then rebuilt in 1672. A major restoration was carried out in the 1780s, partly because of the huge expansion in the pharmaceutical trade operations at the Hall. It is the oldest surviving livery company Hall in the City and many rooms including the splendid Great Hall (where we ate lunch) remain as rebuilt in the 1670s. Many exhibits were on view for us to enjoy, which we much appreciated. I was particularly taken with the Court Dress of John Nussey who was Royal Apothecary to George IV

So, processing into this glorious room, 59 ladies sat down to eat a delicious lunch accompanied by some fine wines. The tables looked beautiful and were decorated with flower arrangements of blue agapanthus and yellow gerberas. Toasts were proposed by the Master's Lady, Mrs Sylvia Price, to The Queen and The Worshipful Company of Engineers. Conversation flowed happily, as you would expect from a group of ladies, until we settled down to listen to our speaker, Mrs Karen Griffiths, one of the Master's sisters, talk about the Bolton Lads and Girls Club. Karen joined the Board of the Club 8 years ago as a Trustee and was Chairman for 3 years.

Without going into too much detail, we learnt that Bolton, home to the spinning and weaving of cotton, was also home to boys as young as 10, who were employed in the mills. After working 10 – 12 hours, six days a week, those boys who had come in from the country side were not able to go home at the end of the day, so slept beside their looms. Endeavouring to provide a place for these boys to go in the evenings, a group of 3 industrialists and 2 churchmen came together and in 1889 opened the Bolton Boys Club, where these youngsters could meet and make friends.

Now, 120 years later, the Club has moved on a pace, but has never lost its simple aims, which is to improve the lives of the most disadvantaged boys (and now girls) in the town of Bolton. It is now in a modern building, built in 2002, offering an incredible range of facilities for the approximately 300 youngsters to enjoy each night. They pay an annual membership of

£5, then 40 pence on the door, which covers any thing they wish to do. Sometimes, we are told, it can become very noisy – as one would expect from so many teenagers, but how wonderful are those helpers who cope with this. There are about 15 volunteers and 10 paid staff on any night to give help and support and generally keep an eye on things.

Karen gave us a few case histories, and as I see it, how wonderful the Club has been to set these youngsters on the right path and to a happy future – how lucky they were to find the Club or in some cases the Club has found them. Which led to their 'Outreach' work, whereby on 4 nights each week teams go out to look for young people who are on the streets, possibly using drugs and alcohol and it can take a while to gain their confidence.

The date of the Luncheon fortuitously coincided with the birthdays of two of the ladies, Molly Wooldridge and Beatrice Crawford here shown with Sylvia Price, Karen Griffiths and another of the Master's sisters Judith Ponsford

Finally, the funding, where does it come from? It seems that it relies on funding from its local patrons and from its fundraising activities as well as some grants for special projects from both local and national government. Also the business community of Bolton has indeed been very generous in helping to sustain the Club over its 120 years.

A vote of thanks for a most interesting talk was given by Mrs Doreen Robinson.

How privileged we Ladies were to dine in this prestigious venue in 2009 and I wonder, would the Ladies in 1709 have enjoyed such a lunch – I think not!

Gayle Leader

INTRODUCING OUR ARKWRIGHT SCHOLARS 30th October 2009

The Master attended the presentation ceremony for our first two Arkwright Scholars held on 30th October 2009 at IET. This is a new Trust Fund initiative to reach down from our traditional support of higher engineering education into school. I was there with The Master and found it an extremely impressive day as each of the 249 scholars paraded on to the stage, at the same time as the audience were told of their academic achievements as well as their other interests and talents. With all the bad press that teenagers get these days, it was very encouraging to see such a group of talented young people who also find time to undertake charity work, play musical instruments at a high level and participate in numerous sporting activities.

The criteria set by the Company for selection of our two scholars were that they should be in the London area and intending to pursue an Engineering career. We also requested one girl and one boy. The selection process included an aptitude test from which 383 applicants were interviewed in March and April of this year and then matched with sponsoring organisation. The two students chosen for our sponsorship are Prerna Aswani from Henrietta Barnett School, Hampstead Garden Suburb and James Routley from St Paul's School, Barnes. Unfortunately Prerna was ill at the time of the presentation, so the photograph shows the Master making his presentation to James only.

The citations for our scholars are -

Prerna Aswani
Prerna has designed a logo which is currently being used by the NHS. A mathematician of some talent, she wishes to further explore the myriad of engineering opportunities. (10 A* GCSE's, 1 A and 1A grade AS level)

James Routley
James rows, sings and plays guitar, clarinet and saxophone. He helps at his local Scout group. He is considering Mechanical, Civil or Automotive Engineering, preferably at Oxbridge. (10 A* GCSE's and 1 A grade)

Since their selection both scholars have already taken the proactive step of writing to us to see if there are any opportunities for work experience and or Job Shadowing. We have asked Liverymen in the London area to seek to engage those who might be able to volunteer to provide our scholars with suitable guidance and, where possible, offer work experience opportunities. Any members interested in assisting should contact the Clerk or Assistant Penny Taylor.

If you would like to know more about the Arkwright Scholar scheme, there is much more detail on their web site http://www.arkwright.org.uk. They are always looking for more sponsors, which are typically drawn from companies, charitable trusts and philanthropic individuals.

The Master and James Routley

We intend to invite our two scholars to one or two suitable events over the next two years to enable more of our Members to meet them and this will add another important dimension to our charitable and educational activities.

Penny Taylor

ANNUAL LIVERY BANQUET THE MANSION HOUSE 30th October 2009

This was another splendid function in the Company's 2009 calendar, one that was supported by some 70 Members and 140 guests, including the Lord Mayor of the City of London, the two Sheriffs of the City of London, and the evening's principal guest, Professor Julia King CBE FREng, Vice-Chancellor of Aston University.

The Master, Wardens and Principal Guests

The Mansion House provides a unique setting for such an occasion, and this was enhanced by the music that was provided throughout the evening by the Connecting Arts Brass Quintet. I would go on to say that, for those Members of the Worshipful Company of Engineers who haven't attended one of these banquets before, then you are certainly missing something special. The organisation was excellent – this was the seventh (and last) such banquet organised by our Honorary Clerk, Air Vice-Marshal Graham Skinner – the food and wine were really good, and then there are those 'special' parts of the evening that do not take place at other dinners. We all "sang" Grace – I say "sang" because there were definitely a considerable number of variations to be heard regarding the notes required, but at least the full set of words were provided. And, of course, we all participated in the Loving Cup Ceremony, a custom that is said to have originated following the murder of King Edward, the Martyr, who was stabbed while drinking in 978 AD. Potential dagger arms were flamboyantly used to remove the lid as one's neighbour drank from the cup. I'm sure many of our guests were very pleased to have participated in the ceremony – having rapidly read the accompanying notes on the procedure required!

We then turned to the toasts and the speeches. I've attended numerous dinners over the years, and I have to say that on many occasions I've been bored by sitting through too many people 'rambling on' for far too long. Not at this banquet however. We had two toasts and two responses and they were all commendably listenable and to the point. The Master, Christopher Price, began the proceedings with references to the construction of The Mansion House in 1739 and other facts such as the costs of dressing the Lord Mayor and the Lady Mayoress at that time – some £309 and £416 respectively. He also presented a cheque from the Company to the Lord Mayor for his 2009 Appeal. In response, The Lord Mayor, Alderman Ian Luder, said this was "his last dinner here at home" as his term of office finishes in two weeks' time. He reported on many excellent messages that he receives about engineers, both in the UK and as he has travelled around the World. He strongly felt that engineers and City investors need to continue to work closely together and do more for society – and he cited projects such as Crossrail, the East London Link, Thameslink, Heathrow and the Olympics.

The Lord Mayor only carries the Pearl Sword in front of the Sovereign. Our Beadle is privileged to carry the Engineers' Sword in front of the Lord Mayor but on this occasion the Lord Mayor turned the tables

The Junior Warden, David Scahill then, efficiently and succinctly, welcomed all the guests and asked all Company Members to toast all the guests. In response

and on behalf of all the guests, Julia King spoke of past collaborations between engineers and entrepreneurs - such as Matthew Bolton and James Watt in Birmingham 200 years ago. She went on to talk about the further huge potential that engineers have with respect to climate change, with a projected 4degC rise in average temperatures by the end of this century. Professor King spoke of the advances that have been made in automobile emissions, but said that this was far from sufficient. She urged all engineers not to stand on the sidelines and criticise – rather to 'go out there and buy electric cars'. 'Take a lead and make a change' she said. 'Make it a golden age for British engineering.' Professor King concluded by proposing a toast to the Worshipful Company of Engineers – may it flourish root and branch for ever.

All too soon the formal activities were over, and there was just time for some informal mingling and networking with friends and colleagues, and then, precisely at the time advised of 10.30, it was out in to the mild evening and carriages, taxis or whatever means were needed to travel home.

As I said at the beginning, this was a splendid Annual Banquet. Well done to Graham and all concerned.

Keith Eaton

The Masters Speech

Wardens, My Lord Mayor, Masters, Sheriffs, Alderman, Ladies and Gentlemen, it is my great pleasure to welcome you all to Mansion House, and particularly to welcome the Lord Mayor and the Lady Mayoress to our Banquet in their own very fine Egyptian Hall. I welcome all the Company's guests and my wife Sylvia joins me in welcoming our personal guests, and our members and their guests.

We really do appreciate the privilege of being able to hold our banquet in this wonderful "house" and to have the full Mayoral party dine with us; we are very grateful to those who prepared and served our sumptuous meal so well; we thank Connecting Arts Brass for serenading us and we thank our small organising group headed by our Learned and gallant Clerk, AVM Graham Skinner, who will be retiring at the end of the year, so this is the seventh and last Annual banquet under his leadership. Please join me in showing our appreciation.

My Lord Mayor, you recently said that this has been a very challenging year to be Lord Mayor. No doubt, a few of the 680 previous holders of the office would claim to have had challenging years too. Despite the announcement of the third quarter GDP figures a week ago, the balance of the pundits is optimistic that the financial position of the City, and indeed of the whole world economy is beginning to improve, and we must thank you for all your personal efforts to restore confidence during your many overseas visits on behalf of the City, and the country.

You must have heard all sorts of opinions about mechanisms to tackle the causes of the crisis, like the measures to make bankers' bonuses relate to longer-term performance. I wonder if Engineers have contributed to these opinions? Engineers are very familiar with the concepts of leverage and gearing as well as balance, resonance, feedback and damping. They know that even modestly stimulated systems in the mechanical and structural fields can run out of control unless properly damped. With plenty of engineering graduates working in financial services, I hope that they are contributing to some re-design of the financial system, to enable it to achieve a sustained high performance as admirable as we see engineers achieving in Formula 1 motorsport; aerospace; electronic communications, medical engineering and many other fields that benefit businesses and individuals worldwide, and that are so reliable that they are simply "taken for granted".

I have no qualms about some of the top engineering graduates working in the City. The skills they graduate with can sustain and build on the 8% of UK economy that the City's financial services contribute. Manufacturing and Construction is now just a quarter of the national economy, lower than in any other leading western economy, but they contribute 60% of our exports. I have some misgivings about such figures, as GDP includes activity that creates value alongside activity that only redistributes value. Adding apples and oranges breaks the rules that engineers are taught, but the point is that Engineers are essential to activities that create value in products and in infrastructure, and in the related services, many of which are exported too. We need plenty of well-educated and trained young engineers to add this value

at home and to enable the production of exports, without which our economy will inevitably decline.

Has short-termism had its day? Will our financial leaders recognise the benefits of longer term investment in the development of more new British products for the world market? Will they encourage the renewal and upgrading of our country's infrastructure which was so well engineered in Victorian times that it has been "taken for granted" for well over a century but is no longer able to contribute to a competitive economy? In short, will they use their undoubted power to encourage and finance the engineering of the future of our economy?

To me, balance is the key. As in energy policy, where engineers know that we must develop and install a balance of low-carbon sources of energy, there must be a balance in the economy. We cannot reject financial products which bring short-term profit, but if they are balanced with longer-term investment, we will prosper for much longer.

Perhaps there's a hint of the right attitude in the Bank of England's decision to introduce a new £50 note next year, featuring two giants of the early industrial age, entrepreneur Matthew Boulton and engineer James Watt. George Stephenson and Michael Faraday have featured on previous banknotes. In the mid 1700s, Boulton built his family's metal products business into an outstanding innovative vertically integrated enterprise, then partnered Watt in steam engine developments which drove the Industrial Revolution. The Governor of the Bank of England said of the new note "So many of the advantages society now enjoys are due in large part to the vital role of engineering and the brilliance and foresight of people such as Boulton and Watt", and went on to talk about acknowledging heritage and scientific endeavour. I would prefer to see this powerful image brought up to date. Rolls and Royce formed a similar partnership in 1904, and today their company is a technological leader and major contributor to the economy and exports, and the term "rolls-royce" is associated, worldwide, with "the best" in any field.

Maybe I am biased, after working for Rolls-Royce, but I think these two gentlemen would be better subjects for a new banknote design. Better still, how about pictures of a group of today's inspirational engineers? They might have to be teased out from the teams they modestly say they are just a part of, but they are there, conceiving and delivering outstanding products, infrastructure and services which will soon be "taken for granted" too. Would you agree that I should write to the Governor and propose such a new design?

Regardless of images on banknotes, our young people are turning to engineering again. It is no surprise that university admissions are higher in a year when jobs are in short supply. It is excellent news that the proportion enrolling on engineering courses is higher still. Increasing the number of young women who study engineering at university has been a priority for many years. There is a lot more latent engineering talent in young women than ever gets the chance to be developed. Julia King, our principal guest this evening is a fine example to young women. Whether they favour engineering science, research, product development, operations, customer service, administration, leadership, advising government, or operating internationally, they have Julia as a role model. It was my good fortune to work with her at Rolls-Royce. She is now Vice-Chancellor of Aston University. She has been acknowledged as one of the "inspirational women engineers of this generation", along with our Liveryman Baroness Platt of Writtle. I will keep a place for them on my banknote design.

Returning to you, my Lord Mayor, we thank you for all the work you have done at home, as well as abroad. We know how much you and the Lady Mayoress have done with the Livery. Your Appeal, "building lives, saving lives" has been a huge success, and you have given even more of your precious time to organisations that work with disadvantaged youngsters, "getting them back on the rails", an expression that engineers understand! Our Company is pleased to contribute to your Appeal and to the Mansion House Scholarship Scheme, and I am pleased to present you with a cheque for them.

I hope that November 15th, the day after you hand over to the new Lord Mayor, will be a happy day for you and for Lin. I have been reading Walter Thornbury's account of the Mansion House and the Lord Mayor's office, written in 1873. After dismissing Mansion House as being "dull but stately" (some present this evening may not know that it was started in 1739 and paid for largely by fines on persons who wished to be excused the office of Sheriff) he goes on to quote Sir James Sanderson, Lord Mayor in 1792, who left minute and fascinating details of the cost of a year in office, with a summary that it cost £309 2s to dress the Lord Mayor for the year and £416 2s for her Ladyship. The pound then purchased 111 times more than it does today. He also quotes a contemporary sketch of the short-lived nature of the Lord Mayor's enjoyment of his role. Returning to his home after a grand banquet on the day the next Lord Mayor is invested and finding his own house so small and uncomfortable by comparison with Mansion House. In the morning he meets a neighbour and good friend who addresses him

without obsequiousness, deference or respect, confirming that he is just an ordinary citizen again. I know that the Mayoralty is a team game and that the person who hands over the baton is as much a member of the winning team as the person who takes it on to run the next lap. I hope you will both be enjoying that success, the morning after the next Lord Mayor's Show.

Would you all please join me in the Civic toast: The Lord Mayor, The City of London Corporation and the Sheriffs.

The Lord Mayor Responding to the Civic Toast flanked by the Master and Sylvia Price

Professor Julia King's Speech

We have been celebrating, in Birmingham, this year, the bicentenary of Matthew Boulton's death. Matthew Boulton is the manufacturer and entrepreneur who persuaded James Watt to come down to Birmingham from Glasgow. At Boulton's Soho Manufactory he provided Watt with the conditions to make the steam engine an economic reality: a skilled workforce, a group of local and patient investors, and a queue of customers: bringing engineering and investment together, as the Lord Mayor has highlighted in his speech. Watt's engine was not the first steam engine, but it was 75% more efficient that Newcomen's. Power and efficiency – two engineering concepts which started the Industrial Revolution.

From 1760 to 1840 – in two generations – power and efficiency changed Britain from a farming economy to the leading industrial nation in the world. (And the engineering institutions were formed and started falling out!)
Well - our time has come again. We have only one generation to move from the fossil fuel society to the low carbon world: 2010 – 2050 - 40 years - for the Green Industrial Revolution.

The engineering concepts will be almost the same: this time it will be efficiency first: much better ways to use the machines we have; and then power: new ways to provide ultra low carbon generation and propulsion, and all embedded in and interconnected by a ubiquitous information and communication environment.

The challenge is urgent – business as usual in global emissions gives a high probability of a 4^oC rise in global average temperature by the end of the century. Southern Spain becomes uninhabitable, not to mention the conditions in parts of Asia and Africa. In climate terms Northern Europe has a reasonably good time – or perhaps it doesn't. Consider the refugee problems – will we live on our comfortable island surrounded by a ring of gunboats shooting at Spaniards – haven't we been there before? It certainly isn't a situation we want to experience again! Being serious, the political and security implications of a '4^o world' are frightening.

So we need to be aiming for a rise of no more than 2 – 2.5^o – since that is what is already unavoidable. That needs a global cut in emissions of around 50%, with an 80% reduction in developed countries – by 2050 – in one generation – in 40 years. It is a big challenge, and a big opportunity for engineering.

Professor Julia King responding to the Toast to the Guests with the Master and Lady Mayoress on her right

Let's just do a quick test to get a feel for quite how big the challenge is. Who drives a car emitting more than 160g CO_2 per km (the UK new car average)? In 2050, if we divide the global allowable CO_2 emissions equally between the 9 billion people on the planet, we each get 2.5 tonnes per annum. If you drive a 160g/km car 15,000 km a year you emit 2.4 tonnes of CO_2.

That is it – nothing left, no clean water, no food, no heating, no housing, no clothes…It is a huge challenge that needs new technology and behaviour change and new technology that helps us change our behaviour.

Let's take cars. The internal combustion engine might get us to a 50% reduction in emissions per km on where we are today, with light weight materials, improved aerodynamics, low resistance tyres, stop-start, turbocharging – and all the ingenious improvements that are being implemented in new vehicles. Impressive, but not enough to cope with the doubling in the number of cars between now and 2030 – from almost 1 billion today to 2 billion globally. We are going to need more like a 90% reduction in CO_2 per km.

So we will need radical change, electric vehicles and hydrogen fuel cell powered cars, charged sustainably. We will need a smart grid – optimising the efficiency and utilisation of nuclear, coal CCS, wind generation and small local generators, and communicating with our homes to switch heating and appliances (and charging cars) on and off to balance the load. The ubiquitous information and communications environment will enable us to travel stresslessly – or manage effectively without travelling. It will be a very different world, with a lot of new technology, and it may still sound a long way off, but it is coming soon.
2050 – 40 years – one generation – 3 car lifetimes.

In the automotive area we have to change and industry which has been perfecting the same technology for over 100 years, and has driven the art of cost reduction to almost incredible heights - a car today costs less than $20 per kg, a laptop, mostly plastic and considerably less intelligent, costs more than $500/kg. So we have to start now… In the UK we need to be aiming at around 1.6 million electric or plug-in hybrid cars on our roads by 2020 if we are to meet our 2050 targets.

So my message to fellow engineers is: don't stand on the sidelines and criticise, that's just creating more hot air, which only makes things worse. When the Government's subsidy scheme of £2,000 - £5,000 per vehicle for electric and plug-in hybrid cars comes in, in 2011, GO OUT AND BUY ONE! Be part of making change happen. This will be a new golden age for engineering. As engineers, let's take the lead, let's participate in the experiments, and let's make this a new golden age for *British* engineering.

So please be upstanding for a very relevant toast.
"The Worshipful Company of Engineers; may it flourish root and branch, forever."

THE WARDEN'S LECTURE
11th November 2009

The venue for the lecture this year was the comfortable and interesting Watermen and Lightermen's Hall, on St. Mary-at-Hill. Appropriately, pre-lecture drinks were served in a room containing a still working mercury thermometer dated 1695.

"If stones could speak, what would they say?", was Junior Warden David Scahill's title, and his main theme was the hitherto under rated contribution made to the buildings and structures of the City of London by Robert Hooke, a seventeenth century polymath and engineer. A contemporary and associate of Wren, Hawksmoor and Newton, Hooke's reputation has been weakened as a consequence of a dispute with the more powerful Newton over the attribution of their work on gravity, and there is even the suggestion that Newton may have plagiarised some of Hooke's work and destroyed the evidence. This theme is interesting enough in its own right, but David skilfully used it as a vehicle to carry a wealth of fascinating additional material on how our City has evolved after the Great Fire. The full text of David's paper follows and a copy will certainly find its place in my own file of facts about the City that are difficult to source elsewhere.

David took questions after an excellent three course luncheon (one served with the compliments of the Watermen's chef, which was appreciated). Two questions concerned the enigmatic Robert Hooke's private life. These David answered with an impressive amount of detail, which however it is not appropriate to reproduce here. However the most lively discussion was provoked by his contention that "finishers" such as Newton almost invariably triumph over "starters" such as Hooke.

The ensuing debate produced two very memorable descriptions of Brunel as being a "wet finger in the air merchant" and a "harum-scarum who did not care if he killed people, living off of his father's reputation" although my understanding is that these views may not

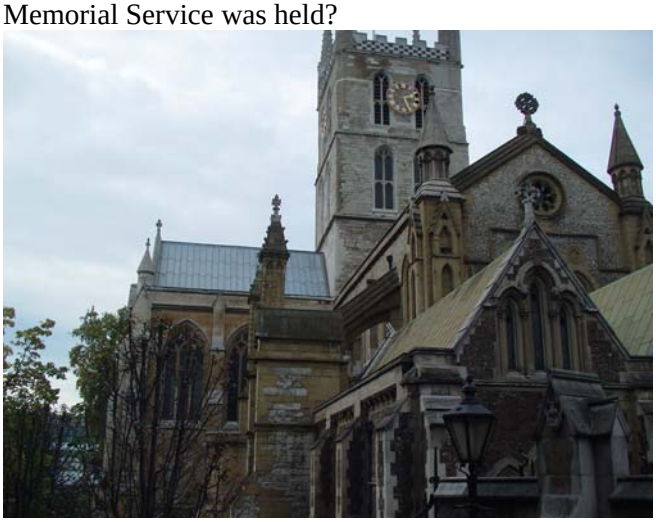
necessarily be officially endorsed by our Worshipful Company!

All in all, the event was informative, entertaining and convivial. David confided that in the course of researching this lecture he had discovered enough material to give another, which might be called "The things the Victorians destroyed." I, for one, hope that he might consider doing this at some time.

Keith Clarke.

If Stones Could Speak

Ask anyone to describe a typical English church and they will probably describe a little village church (St Peter and Paul Great Missenden where Past Master David Mitchell's Memorial Service was held) or one of the Victorian Gothic revival churches. And think of a typical cathedral – Salisbury? or Winchester? or maybe Southwark where Past Master Denis Rooke's Memorial Service was held?



But in the City of London there is arguably the largest concentration of church buildings of outstanding quality anywhere in the country and not one of them could be described as a typical English church. And the most famous of all, St Paul's Cathedral, whilst being spectacular is certainly not a characteristic English cathedral. In London we have the biggest and finest collection of Baroque churches outside of Rome.

You will know from the invitation to attend today that my lecture is scheduled to reflect on the largely unsung influence engineers have had on the development of the City of London and the character of the buildings and the heritage we see today: If stones could speak – what would they say? The towers and spires of the City churches have seen it all.

By the bye, I would like to share with you the derivation of the title of my lecture "If stones could speak." It is the title of a charming book of City church anecdotes which was written by Miss F St Aubyn Brisbane (Gill and I call her Fanny), and published in 1929 and which we originally came across in the Guildhall Library.

But the talk I will give today is not the one I had planned at the start; instead it has grown out of the reading and research we have done since becoming acquainted with Fanny, when we have been studying the history of the City churches and their continuing development.

I was going to give you a guided tour of some of the curios mentioned by her. St Dunstan's in the West, at its side King Ludd and his sons according to tradition buried in Ludgate, or Good Queen Bess's only statue completed in her lifetime and the only external statue in the country, or the first clock in London to have a minute hand, and the giants with their clubs to strike the quarters.

Or St Magnus the Martyr, just over the road from here, the porch of which was the approach road to the Old London Bridge, seen here in a sketch of 1810, after the buildings on the bridge had been removed, and before it was replaced in 1831. Or St Mary le Bow, from where the Plantagenet kings and queens observed the Jousting and other spectacles of chivalry, in medieval times. And where you will see a plaque on a bust mentioning Sir Peter Gadsden by name.

And as for the unsung heroes, I was going to tell you about the origins of the underground heating schemes put in by the Romans, remains of which can be seen in the crypt of St Bride's church.

Or the ingeniously designed self latching coffin lid which operated as the lid was closed causing latched leavers to lock into slots in the coffin walls. This was to ensure that grave robbers were unable to snatch the bodies of the dear departed to sell to researchers. Again this can be seen in the crypt of St Brides.

But as we built up our knowledge of the churches, we saw more and more, the reference to one particular "unsung hero."

So, what I want to do today is to tap into the history of London shortly before the Great Fire and follow the development of the City from a mainly engineering perspective.

But before doing so I will set the scene, of the genesis of a small group of scientists and philosophers, who had been meeting together throughout most of the 1650s in Oxford and who within a decade would form the original Fellowship of the Royal Society.

And it was in Oxford that my particular "unsung hero for today" - Robert Hooke - began his apprenticeship to science and formed a collection of influential and creative friendships.

When Hooke died on 3 March 1703 in his lodgings in Bishopsgate, he had around him more than £1 million in cash, in today's money, but he died alone. After his death, and for nearly three centuries his name disappeared from the record, his instruments disappeared (some say broken up) and the only portrait of him disappeared from the walls of the Royal Society allegedly destroyed on the orders of Sir Isaac Newton, the then President of the Royal Society, and the only contemporary scientist not to attend his funeral.

He was buried at St Helen's in Bishopsgate but even there circumstances prevailed against him. In 1892 the church authorities sought permission to relay the floor of the church but the City Sanitary Authorities complained of the smell. The remains of those buried in the church were exhumed. Some were reinterred in the church, but Hooke's remains were taken with the rest and lie without record in communal boxes in the City of London Cemetery at Wanstead.

Even the only memorial stained glass window to him in St Helen's was destroyed by the 1992 IRA bomb although we have not turned up any evidence that this was the bombers' objective even though they had a second go a year later!

Engineers know and use Hooke's Law of Elasticity, but without this his name may well have been completely forgotten.

However two of his diaries were discovered in the sale of household goods from Moor Hall, Harlow in 1891, now in the Guildhall Library, and it is from these that we can gain an insight into his fascinating mind and character and his effect on the development of so many branches of science and engineering and of the City itself.

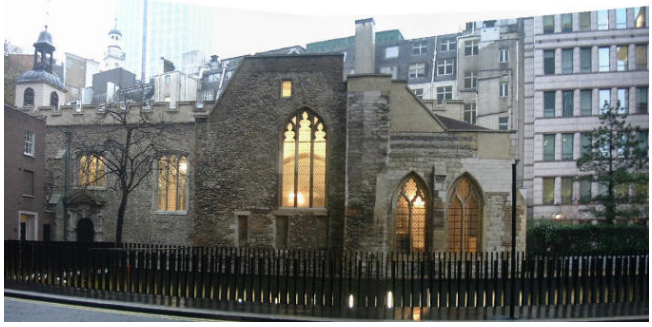
We must remember that for centuries before Hooke's time, science and philosophy had been more or less moribund with the continuing emphasis on the world of the four elements: earth, fire, water and air.

Columbus's discovery of America in 1492 discredited traditional geography, Tycho Brahe's supernova of 1572 and Galileo's discoveries in 1609 and the rapid developments in optics shook classical astronomy. Harvey's understanding of the working of the heart was the genesis of modern anatomy.

This was the time of **experimentation** over **intuition**, **doing** rather than **surmising**, **engineering** over **philosophy**. Sir Francis Bacon, an early champion of experimentation, wrote that "nature must be put to the torture" or "to the question." And this is what Hooke did, exquisitely!

Robert Hooke was born in Freshwater on the Isle of Wight in July 1635, the son of a clergyman. As a young boy he was absorbed by the natural world - light, gravity, energy and motion – the elemental forces of nature. He was an extraordinarily quick learner and possessed a manual dexterity which enabled him to build an impressive array of mechanical devices which he used to investigate these forces which he intuitively considered to be of vibration.

A brilliant artist, and initially destined to follow an artistic career, he changed course and went to Westminster School, the same school, some say, that Christopher Wren attended, under the headship of Dr Richard Busby, who became a life long friend.



At Westminster, Hooke quickly mastered ancient languages, read the first six books of Euclid "Elements" in a week, learned to play the organ, sang beautifully, allegedly devised thirty different ways of flying and designed flying machines amongst other things!

He went up to Christ Church, Oxford where he had to work in service to other students in order to pay for his studies.

He came to the attention of Dr John Wilkins, Warden of Wadham College, who was the leader of the Oxford scientific 'Club', who encouraged him in astronomy, mathematics, and mechanics, as did the young Christopher Wren. The two became close colleagues and friends. They had so many shared interests – mathematics, astronomy – and subsequently both becoming committed architects.

Hooke's experimental abilities were honed and developed when from 1658 he worked as Robert Boyle's assistant for whom he designed an improved "air pump" (the first in England) which enabled Boyle to conduct his experiments on the atmosphere and which ultimately led to his discovery of Boyle's Law.

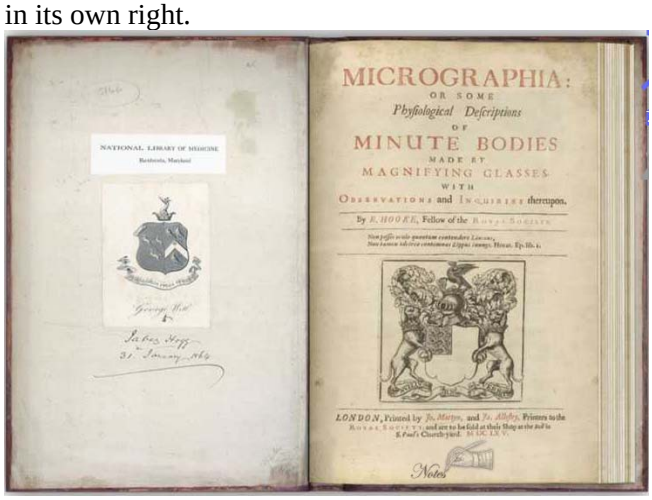
'The Oxford Philosophical Club' also met at Gresham College in London and after the Restoration of the monarchy in 1660 was granted a Royal Charter to become a college for the promoting of 'physico-mathematico experimental learning.' later to become 'The Royal Society of London for Improving Natural Knowledge', today's Royal Society.

Robert Hooke was appointed as paid Curator of the Royal Society in 1662, charged with furnishing experiments for the fifty or so meetings each year; he was initially an employee (or servant in the terminology of the day), not a member.

In 1665, at the age of 30 years, his academic standing was confirmed when he was appointed Professor of Geometry at Gresham College, with rooms and accommodation in the same building where the Royal Society held its meetings. This for the first time in his life gave him financial independence; and by then he had become a full Fellow of the Royal Society.

By the bye, it is in this capacity that Hooke also lectured to the boys of Christ's Hospital, a bit before Past Master Bawtree's time!

It was in 1665 also that Hooke's book ***Micrographia*** was published – the blockbuster of the decade – which enabled readers to see plates showing the minutest details of the flea, although they didn't know that it would be the cause later that year of the Great Plague, or the stinging nettle, the drawings a combination of Hooke's novel design of microscope and his expert drawing skills. And this is a topic worthy of a lecture in its own right.



So in 1665 Hooke had acquired those physical circumstances that would see him through the remaining thirty-eight years of his life. They also made him the first salaried research scientist in Britain.

And now we are in the London of the 1660s. Its population had grown from about 75,000 in 1500 to some 200,000 by 1600 and had almost certainly doubled by 1660.

The Great Fire began in the small hours of Sunday 2nd September 1666 at Farriner's Bakery in Pudding Lane and residents watched in growing alarm as the fire spread.

As with many disasters, had appropriate action been taken quickly then the fire could have been brought under control. But when awoken from his bed at 4 am the Lord Mayor observed that "A woman might piss it out!"

But it spread quickly, fanned on by a keen easterly wind and was soon completely out of control.

By 2 am on the fourth day the cathedral was well and truly alight. The stones "flew like grenades, the melting lead running down the streets in a stream."

Old St Paul's was a magnificent, huge medieval church; compare it with the size of the current St Paul's as shown on the floor plan in the cathedral yard – (the existing St Paul's is shown in grey).

It had had the highest spire in England, but in 1561, a century before the Restoration, it was hit by lightning and caught fire and collapsed, severely damaging the tower. The alternative explanation is that the fire was

caused by a verger who slipped into the tower for a quick pipe of tobacco!

The state of the tower worsened as a result of the neglect of the Old St Paul's in the Civil War and the interregnum.

When Charles II returned in 1660, he found a severely damaged building and one of the first things that he had his team of surveyors in London do, was a complete survey of Old St Paul's.

His intention was to finish the job started in the 1630's by his father who ordered the external renovations, carried out by Inigo Jones, who hung a stunning new marble façade on the front of the building and refaced the nave and transepts with Portland stone.

Christopher Wren was one of the three king's surveyors who were put on to the job of structurally analysing Old St Paul's to see whether it would stand refurbishment, or whether something more dramatic might be needed, like complete rebuilding. This they undertook in 1663.

He proposed to replace the entire crossing with four massive piers carrying a lofty dome. The drawings were formally approved on-site on 27 August 1666 – a week before the start of the Great Fire.

It is interesting to note that Old St Paul's cathedral towered over the small timber framed houses of the day, so that when the fire started, it was thought to be a place of physical safety, so many city merchants rushed to store their goods there.
But due to the parlous state of the tower, it had for years been shorn up by wooden scaffolding. And it was this scaffolding that provided a pathway along which the fire was able to reach the roof and therefore burn the cathedral down! The printers of Stationer's Hall alone lost £2 million in the conflagration.
But back to the fire!

At 2 pm on that same fourth day, the east wind dropped and the fire started to abate.

It was up to the Lord Mayor to give instructions for houses to be pulled down to make fire breaks, but he did not. Without these instructions householders would not be entitled to compensation and the Lord Mayor was unduly concerned about the cost of issuing such an order. However, at this time the King ordered his brother, the Duke of York (later James II), to take charge, and the necessary intervention to calm the flames started.

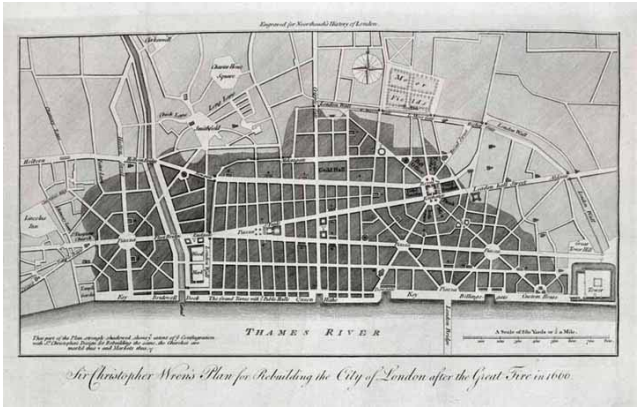
By 1 pm on the 5th day, the fire was out.

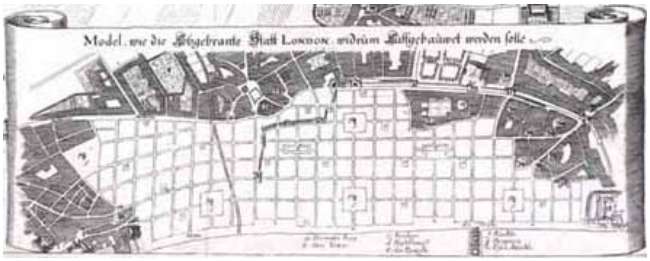
Although fires were not uncommon in such an overcrowded city, where wooden buildings crowded together, this, the Great Fire was catastrophic. It destroyed over three quarters of the City as shown by this contemporary print, and the disaster was felt by the whole nation as in total it cost an estimated 10% of the total wealth of England at that time.

King Charles II appointed a commission to plan rebuilding, which had to be done quickly in order to avoid merchants and citizens moving elsewhere; unusually he and the Lord Mayor were both closely involved in the process. 400 acres within the city walls and 63 acres outside them were affected by the Great Fire. 87 churches, 44 livery halls, 13,200 houses, the Royal Exchange and the Guildhall were all partially or totally destroyed, but amazingly only 9 people were known to have died.

Within days of the extinguishing of the Fire, a number of plans were brought forward, some to the Corporation of London, at least one to the Royal Society and Christopher Wren's to the king. Wren had 'favoured son' status with the king – they had probably played together as children in Windsor Castle where Wren's father was the Dean of the Chapel Royal – so he actually presented his design to the King himself.

Of the three recorded plans one was by Wren, and one was by Hooke although this too disappeared; the plan shown was from a 1720's German engraving of the Fire.





These plans proposed razing the old city and replacing it with some grandiose new scheme. Wren's was very European, on the model of Louis XIV's Paris. Hooke's more like the future North American city plans.

But in a very careful democracy such as we had in England in 1666, it was out of the question to evict all the wealth generating residents and rebuild the City with these grand boulevards and monuments. A decision was taken by the Corporation of London that householders could get back their plots of land. A decision of democracy over autocracy. It also suited the City merchants who wanted to get back to work as quickly as possible.

And this is where Robert Hooke became part of the team. He was one of three Surveyors of the City of London who were responsible for staking out every street and pavement in the City. This was in addition to his "day job" at the Royal Society and the experimentation he was still undertaking for Robert Boyle.

In order to get compensation for the rebuilding of their properties, it was necessary for each owner to obtain a certificate of title from a City Surveyor. And to provide a signed certificate Hooke had to stake out the area of the property. And to do this Hooke had also to stake out the road system on its original lines but with minimum widths of 14 feet for side roads and 40 feet for main roads.

Property owners had to pay a fee for each certificate signed and delivered, and since Hooke has been credited with between 3,000 and 5,000 of the 8,000 title certificates this made him a very rich man as well as a busy one!

Christopher Wren's involvement with the subsequent rebuilding of London is well known and documented but not so much the extraordinary involvement of his friend and associate - Robert Hooke who, in addition to all his other roles and responsibilities, also joined Wren's team in the salaried position of chief officer and engineer to the Wren architectural office.

He designed many of the new buildings and contributed directly to their improved architecture and increased functionality. Several of his buildings are still incorrectly credited to Christopher Wren.

It was decided that 51 of the churches would be rebuilt, and that Wren and his team would have authority over the work.

Besides Hooke, Wren also had the services of a brilliant young apprentice architect and designer, Nicholas Hawksmoor, whose hand is seen many times, and who like Hooke, but much later, also designed and supervised the building of churches, in, and around the City. Probably his most famous church is St Mary Walnoth just beside Bank station, and for the early years of the Underground at Bank, its crypt entrance doubled as an entrance to the station. It is still to be seen today outside the church, although no longer in daily use.

It was he who more than anyone extended the baroque style of architecture through the bizarre - into the macabre. And there are tales of the occult surrounding him, but that is definitely a topic for another day and another place.

So back to the rebuilding programme!

The restoration of London, more or less on the original street lines, started very quickly and by the time the Wren team got round to their main church rebuilding programme, the sites for them had been defined by their former outlines with bits taken off here and there to provide for wider roads and other requirements. So

most of them were to have odd floor plans, no two were the same. A lot of these sites are curiously wedge-shaped, cut off at one side, angled, too small, hemmed in by houses.

But this is where the geometric mathematical ability of Wren and his spatial awareness enabled bespoke solutions that resulted in the appearance of perfectly proportioned harmonious space on the inside of buildings which have the most irregular and curious shapes on the outside.

If you have time go and look in St Mary Aldermary church, an example of a most charming and well proportioned church interior lurking inside of a quite deformed external body shape!

Wren perfected his art of illusion in St Stephen Walbrook which is actually a rectangular church. But because of the dome and the way the pillars are arranged and the way the light enters, it looks square and more like a Byzantine church than the traditional British - Greek cross - style.

St Stephen Walbrook is generally accepted as Wren's prototyping for St Paul's especially the dome, and is remarkably similar to the great model for St Paul's, which a number of us saw earlier in the year during a visit.

St Stephen Walbrook's has a self-supporting dome with an oculus, or a central hole, recalling the Pantheon in Rome, which supports a lantern through which the light falls into the centre of the church. You have a similar effect in St Paul's, but because of its size in a much larger and taller building, its construction could only be achieved by much more complicated structural techniques which I will talk about later.

But before moving on to the design and construction of St Paul's, I just want to provide another little example of Wren's brilliant spatial awareness and artistic flair.

When a church well known to the Clerk elect, the church of St Martin within Ludgate was rebuilt by 1680, it had been moved back some way from its original site to provide for the widening of Ludgate Hill.

Even so, Wren had decided at the outset that he wanted travellers coming through Ludgate Circus to have a view of the dome of St Paul's bisected precisely by the spire of St Martin's even though the dome of St Paul's would not be topped out until 28 years later. And so it does! at least from the lower deck of a Number 26 London bus and….from the upper deck of a Number 11!

But back to St Paul's, its design and its construction.

It was the King and Corporation of London together with the Anglican Church who had authority over the design of the new cathedral. Both the Corporation and the church were very much "low church" and totally opposed to the baroque magnificence which described the European catholic church of the time and which had been much admired by Charles II whilst in exile in France.

After the decision was taken in 1668 that the Old Cathedral would be demolished rather than rebuilt, Wren submitted his first plan based on a Greek Cross in 1669 but this was rejected; only a small proportion of the model remains in the Model Room in St Paul's.

His second submission in 1673 embodied in "The Great Model", was also rejected much to the great disappointment of Wren.

So when he submitted his third proposal in 1674, approved by the King, and so called "The Warrant Design", he proposed a building which ticked all the boxes of the expectations of the low church, rather than satisfying his own ambitions, and not surprisingly this was accepted by the City and the clergy.

But it was almost certainly a conspiracy hatched between Wren and Charles II to present "the Warrant Design" for approval by the Church of England and the City aldermen, which in fact turned out to be "a roman baroque wolf hidden in low Anglican sheep's

clothing," because neither man intended that the finished article would have the slightest resemblance to it!

Gill and I were standing in St Paul's as guests of Don Pritchard last week, and he showed us in the nave, how Wren exquisitely moved from "warrant" to "current" in three easy arches!

Perhaps Don, you would explain to us all over lunch how this was achieved.

The King actually gave Wren some freedom to act saying that he was permitted to make changes "decorative rather than essential."

And as the cathedral took 35 years to build, the work on which was largely obscured from view, few of those involved with the original approval were around to object to the architectural deceit.

Indeed the construction from start to finish was all under the continuous supervision of Wren, the only cathedral to be completed within the lifetime of its designer. Wren died in 1723.

Wren developed much of the design as he went along, in the form similar to that which he had originally envisioned and which would have very much pleased Charles II had he lived beyond 1685.

Wren's continuous progression of the design was made possible by the use of a novel sort of "shorthand" drawing style that he and his team developed and which enabled the complex details of form and build to be turned into physical fact by the teams of largely semi skilled workers, under the supervision of skilled masons, that were employed on its construction.

So on to the design

We know that from many entries in Hooke's diary for the period, that Wren took notice and relied upon Hooke's structural engineering expertise in the construction of the body of the cathedral and substantial support pillars which were necessary to support the massive dome and lantern.

We also know that Hawksmoor was responsible for the drawings of the dome, but Hooke certainly influenced its design, suggesting that it should be double vaulted to provide sufficient strength to support the 850 ton lantern above the oculus.

He also influenced its shape because he realised that the ideal form for a dome was an inverse catenary. Hooke's diary of 1675 reports that Wren used this principle in deciding the shape of the dome and its supporting arches.

It should be remembered that Hooke and Wren shared a close friendship, Wren being three years older, their constant interplay, possibly at Westminster School, at the Royal Society, and the years of major reconstruction of London after the fire.

So ideas and recommendations for building design would have been exchanged freely between them; they were interlocked, the designer and the engineer, in a way that seems to be extremely modern, the Foster or Rogers teams of their day!

In the dome they created an optical illusion of looking up through an aperture in the top of the dome to see what seems, when standing under the centre of the dome, to be the sky. It is actually a vertical shaft, at the top of which is a second aperture indirectly lit, which then supports the lantern. This is exactly the same form as was used in the construction of 17th Century microscopes as used by both men, but not used anywhere else in a building, as far as we know.

Again Wren's spatial awareness and geometrical eye is evidenced by what appears to be a single dome from inside and out, is in fact a construction of three domes,

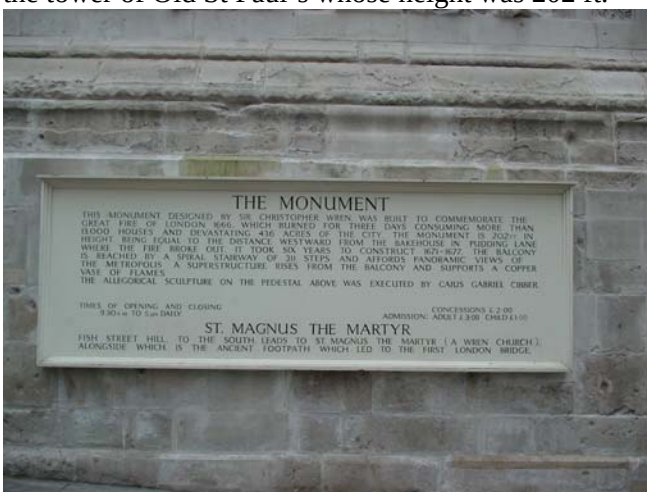
the inner, outer, and a conical support dome for the lantern on the top.

The construction of St Paul's had reached the level of the Whispering Gallery by 1698 and the building was "topped out" 10 years later in 1708 by Wren's son.

As another interesting aside the records of the Cathedral show that Wren was lifted in a basket, each week, up into the dome to inspect progress even though by then he was in his 70's.

And another little snippet: by 1697, a year before the start of the dome construction, Parliament had become impatient with the slow pace and halved Wren's salary with the retained half only being paid on completion. What would the City think of that now!?!

Wren and Hooke through their Royal Society membership jointly experimented on astronomy and on pendulums, thermometers, barometers, weight and gravity and their variation with height. They loved tall buildings, using the towers of Westminster Abbey and the tower of Old St Paul's whose height was 202 ft.

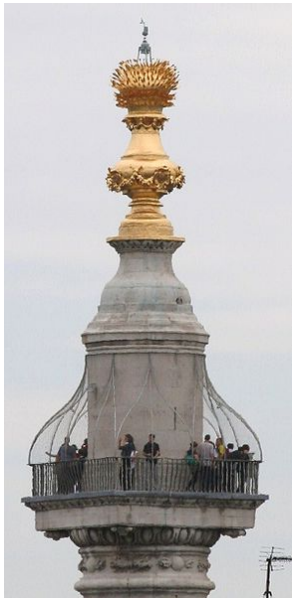


So when they set about rebuilding St Paul's they had what you might call a "God given" opportunity to build a cathedral-cum-scientific-instrument for their personal use over the 35 years it took to build.

The south west tower especially was built to provide this dual purpose, having a stone staircase carefully built around the outside to provide a central vertical shaft. One of Wren's drawings shows the shaft and then a little paper fold-out revealing its roofed form. Before that the shaft housed a telescope using two magnificent lenses that had been donated to the Royal Society by one of the Huygens brothers.

However, the Monument, built 1671-7, is really our lasting tribute to the sort of synergy between art and science that Wren and Hooke had a lifetime investment in. Actually designed by Hooke, and still on its plaque ascribed to Wren, the "Fish Street Hill Pillar" is the tallest free standing Doric column in the world, at 202 ft of Portland stone, the same as the tower of Old St Paul's, and also the distance between it and the place the Great Fire started in Pudding Lane, a couple of streets from here.

We know it was something of a joint Hooke/Wren inspiration because Wren wanted a golden bust of Charles II on top but in this he deferred to Hooke's choice of the flaming urn of gilded copper we see today; both ideas symbolising the rising of the restored Stuart monarchy out of the ashes of the Commonwealth as well as the City rising from the ashes of the Great Fire.



But more than a monument it was devised and designed as a permanent scientific laboratory: little niches where the scientist sat to take measurements; 311 steps radiating around the vertical shaft to the balcony at the top, where Wren and Hooke took measurements at every level to check barometer readings.

Hooke with his mercury barometer, discovered a drop of approximately a third of an inch, in atmospheric pressure from bottom to top.

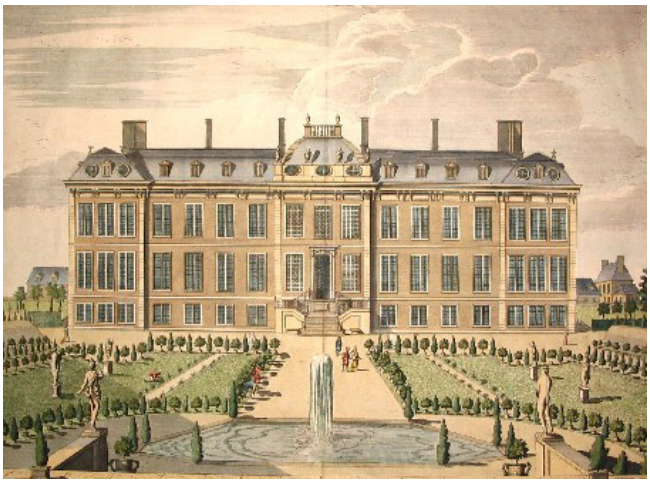
Hooke also intended to use the column to test his theories concerning the use of pendulum clocks and the effects of gravity on them when placed at different heights from the earth's centre of gravity. The experiment was proposed to the Royal Society on 17th December 1681 although there is no record of it actually being carried out.

Finally he compared the weight of a pendulum in the base and at the top of the column to determine the difference. Unfortunately he was unable in this case to prove his theory due to the insufficient sensitivity of the scales available at that time.

Although he was gifted, Hooke's architecture was not as brilliant as Wren's, and like so many of his other activities little remains of them. His buildings have had a disastrous survival record. Most of what had survived into the nineteenth century perished in the wholesale remodelling of Victorian London. Even the Second World War took its toll, when the magnificent

wooden screen which he designed for the Company of Merchant Taylors' was destroyed by a bomb.

But we do know from records the quality of his designs for The College of Physicians, which until the discovery of Hooke's diary had been ascribed to Wren and for which Hooke invented sash windows; the Bethlehem Hospital (more famously known as Bedlam), many Livery Company Halls, part of the Thames and Fleet waterfronts, private residences in St James' Square, and great mansions, like Montagu House built in 1679



Described by some as the only surviving Hooke designed building, the church of St Mary Magdalene in Willen, Buckinghamshire (near Milton Keynes) was designed for his old friend and Westminster Headmaster Dr Busby, who we spoke of earlier, and who was patron of that living. It is almost a facsimile of St Benet's in Paul's Wharf which is still described as the least altered surviving Wren church!

However, according to some biographers there are a goodly number of buildings designed by Hooke still extant but are not popularly acknowledged as his – the Royal Observatory being one!

Let's just review then, Hooke's contribution to science and our world.

It was he who first proposed the inverse square law of gravitational force. No, Newton I hear you say! I'll come back to it later.

He played a crucial part in discovering the law of expansion of gases that we know as Boyle's law.

He discovered the law of elasticity. *Ut Pondus, sic Tensio.*

He invented the balance-spring mechanism to drive an accurate time piece and free from external forces.

He invented the universal joint still used in car drive shafts as well as many, many other applications.

The sash window!

Hooke's prototype lens-grinding machine and his technical components for telescope and microscope-manufacture and operation, were a vital part of the experimental foundation, for the European scientific revolution.

He significantly improved designs of telescope, microscope, air-pump, thermometer, and many other instruments. By the by, the only known surviving pieces of Hooke apparatus are the eye and object lenses of a telescope in the Royal Observatory, the world's first dedicated stellar observatory.

It was Hooke's groundbreaking structural engineering that allowed Wren to achieve his architecturally innovative design for the dome of St Paul's Cathedral: a structure weighing 65,000 tonnes!

Within Micrographia, his microscopical examination of ice crystals presaged discussion of atomic structures; he first recognised the cellular structure of wood, inventing the word "cell."

He initiated research into the role of air in combustion; and how the anatomical description of a fly developed into an experimental essay in aerodynamics, acoustics, and wave-patterns.

He even conducted the first recorded blood transfusion, transfusing the blood from living sheep into a very drunk madman who survived although the sheep didn't! and on and on.

To quote one of Hooke's biographers:

"He was an experimental scientist, a man who laboured intensively to open up new ideas and promote questions in others concerning our natural world -

often providing the right 'doors' in the early maze of scientific exploration for others to enter.

Each 'door' was the starting point to a 300 year journey of discovery, proof, and advancement down separate paths which many great scientists then travelled; each path - a discipline of scientific research. It was Robert Hooke, in his role as curator of experiments for the Royal Society, who prepared each pioneer for his journey. He brought each to a new door he discovered. He provided each with a rudimentary but accurate map, contributed the torches to light their first critical steps... then guided his fellows as they entered the darkness!"

So why do we remember Sir Isaac Newton, Sir Christopher Wren, Edmond Halley and Sir Robert Boyle while Robert Hooke has for centuries been largely forgotten and unknown?

Some scholars have said that it was Hooke's feisty temperament that was the cause; he was cantankerous and quarrelsome, and had a chip on his shoulder when dealing with his peers.

It has also been suggested that the basic problem was Hooke's class - he was not a born gentlemen.

It is true that Hooke's reputation suffered because of his disagreement with other scientists over questions of fact and of priority.

All of Hooke's biographers recognise the deep personal cost to Hooke of his open disagreements first with Christiaan Huyghens over the invention of the spring regulator, and more seriously with Isaac Newton first rubbishing Newton's work on optics (1672) and probably more significantly in 1687, after the publication of Newton's ***Principia Mathematica*** when he openly declared that he first proposed the inverse square law of gravitational force.

In a series of exchanges in 1679 Hooke wrote to Newton explaining his theories on planetary motion which he considered to be a force continuously acting upon the planet and diverting it from a straight path. Newton wrote back explaining his theory of the Earth's rotation, based on his premise that the force of gravity was a constant. Hooke responded with his own theory of planetary motion stating he considered gravity to involve an inverse square law and was not constant! Newton's repost was "merely because one says something might be so, it does not follow that it has been proved that it is!"

The problem with Hooke was that although he had a brilliant intuition, his mathematical ability did not match it, and so he was unable to prove his hypotheses in a way which Newton, later, did.

Sir Isaac Newton became President of the Royal Society in 1703 the year that Robert Hooke died. So was it coincidence that shortly afterwards, all Hooke's instruments and experiments disappeared from the Royal Society and from his rooms in Gresham College, and even the painting of him which had hung on the wall of the President's chambers?

Then it might also be an uncanny coincidence that Hooke's design for a marine chronometer, lost until 1950, actually turned up in the library of Trinity College Cambridge, Newton's old stamping ground!

I wouldn't dare comment, but others have and laid the blame for Hooke's fall into obscurity squarely on Newton!

As an aside Hooke's design for an effective marine chronometer was invented 100 years before Harrison's and if that had been seen through, just think how would that have further enhanced England's already dominant naval position. But Hooke's bad luck was again evident because it had been agreed that he would take out a patent for the clock through the Royal Society, but at that time in 1665 the Great Plague struck London, and the patent documentation was removed with all the Society's other papers to Oxford, never to be pursued thereafter.

So, cantankerous? Argumentative? Yes, but many of his contemporaries were as well. But those with whom he quarrelled were more focussed on extensive research, or mathematical computation, into many fewer subjects, and when disagreements broke out, they were able and willing to spend the time and effort to secure their positions.

The victim of others' professional jealousy? I leave you to draw your own conclusions from what I have already said.

Being the wrong class? Unlikely. He died a wealthy man; was recognised across Europe for his theoretical and practical contributions to the new science; had been honoured by the City for his part in its restoration, had mixed with kings and noblemen, and was a close friend of Boyle and Wren.

While the cause of his obscurity may have had elements of some or all of the above, I feel that much of the problem was that Hooke was simply too

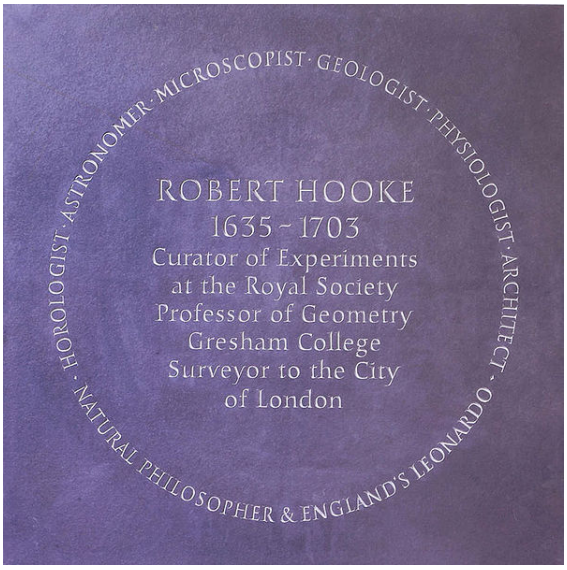
involved in too many things, over too long a period to cement his reputation in any of them; his many brilliant insights were interspersed with his many day jobs, and as these resulted in many correct ideas and discoveries remaining incomplete or lacking registration or publishing, it allowed others to do so and take the credit of history.

I have often said that people are remembered for what they finish, not what they start. I suspect that this could have been a major reason why Hooke slipped into obscurity for such a long time.

Hooke wrote to Sir Robert Boyle in 1667 "Many other things I long to be at, but I do extremely want time." He was 32 years old and at the peak of his powers. This could have been his epitaph.

His towering intellect and contributions are at last starting to be recognised.

On 3 March 2005 a stone was laid in the floor of Westminster Abbey to acknowledge the significant support Hooke gave to Dr John Wilkins, Warden of Wadham College, leader of the Royal Society, mentor and friend, in his reordering and restoration of the Abbey.



In January 2007 a plaque was placed in the pavement close to the foot of the Monument in part acknowledgment of his involvement in its creation.

And most recently, in November 2008 a plaque was unveiled in St Paul's, next to Wren's tomb, in recognition of Hooke's part in the construction of the most beautiful baroque cathedral outside of St Peter's in Rome, St Paul's.
So, if stones could speak, what would they say?

Hooke's long time friend, Sir Christopher Wren, has his epitaph surrounding his memorial in the crypt of St Paul's: "If you want a memorial, look around you."

Whether you stand on the lantern of St Paul's, or on the top of the Fish Street Hill Monument, or on any of the church towers or steeples overlooking the streets of the City, their stones would cry out:

"If you want a memorial to Robert Hooke, look around you!"

Or – maybe - to follow on from the Master's Mansion House speech, about celebrating the contribution of brilliant engineers by including their portraits on UK Bank notes, maybe there is just one case for celebrating the old, instead of the new, maybe Robert Hooke's lasting memorial could be on a new £100 note!

Or maybe not - as we do not have a likeness of him to use!

David Scahill, Junior Warden

LORD MAYOR'S PROCESSION November 14th 2010

The omens were not good. The Met Office was issuing severe weather warnings for the South of England, threatening gales and heavy rain likely to cause flooding. The BBC news was no better – only Spain and UK, among the major European nations, had still not recovered from recession. But the morning started surprisingly well, with even some welcome sunshine as some of us travelled up to the City by train.

After a short walk across the City, the coffee and the greeting in the Wax Chandlers' Hall was most welcome, and provided the ideal opportunity to prepare ourselves to face the elements.

The Master and Assistants Barry Brooks, Clive Walker and David Johnson ready for the Procession

As 11a.m. approached we set off to view the procession. It was cool, and breezy – but dry and bright, with largely clear skies. Nevertheless, we saw no sign of the promised RAF flypast. Maybe the weather got the better of them, maybe we had lingered too long over the coffee, but we saw nothing of them.

The Solicitors

By 11 we were at our chosen viewing spots, the bells rang out joyfully, and the assembled parade started to wend its way through the City. For the next hour and a quarter, the weather remained fair and the parade delighted. The bystanders waved and smiled as the procession walked, marched and rode by, representing not only the liveried companies but many other aspects of life in the city. There were many marching bands to

A Four Wheel 'Wheelie'

entertain, both military and civil, and troupes of dancers – the roller bladers being particularly entertaining. The motor-cycle display teams were happy to demonstrate their tricks for the crowds, with some very impressive four-wheel "wheelies". It was good to see so many young people participating in the traditional event, on the decorated floats and in the many groups from the cadet forces.

Some of the Companies were particularly noteworthy; one of the early highlights on a cold morning was the sausage samples from the Butchers, and the highly colourful animal costumes of the Solicitors were very eye catching – and assuming their reference to the 'law

Back to the Steam Age

of the jungle' was tongue in cheek, it was good to see that lawyers can display a sense of humour. We waved

when the hardy team from the Engineers paraded by with the rest of the Modern Companies, placard bravely held high.

The Lord Mayor's Coach

There were reminders of days gone by also, with the steam-powered vehicles reminding us that pollution in London could be worse! Towards the end of the procession, the carriages carrying the Lord Mayor and other dignitaries were both an impressive sight and a reminder of the long history of the event.

Just as the tail of the procession passed us by, the skies darkened, the gusts blew up again, and the heavens opened. We scampered back to Wax Chandlers' Hall, holding onto and hiding under our umbrellas and our waterproofs.

The Brave Walkers Return

Lunch was soon underway and most enjoyable, and before we realised it, the return procession was trooping past the windows. We have to admit that lingering over the wine now proved to be more attractive than returning to the streets, so insofar as we watched the return at all, we largely watched from the windows of the Hall. But we couldn't make lunch last forever, so finally we donned our warm clothes again and set off to enjoy the afternoon.

Our first thought had been to join one of the conducted tours of the city, but one glance at the queue convinced us that we would do better setting off by ourselves. It is a rare pleasure to walk through the City when the streets are devoid of traffic and the remnants of the procession are drifting off homewards, The occasional gale force blast occasionally caught us unawares as we rounded a corner into a makeshift windtunnel, and crossing the unprotected Millennium Bridge was quite an experience. But the rain stayed away for most of the afternoon, and resisting the gusts became part of the fun.

St Paul's Cathedral and the Millennium Bridge

It came as no surprise when we picked up the announcement that the fireworks had been cancelled. Naturally it was a disappointment, as we had been looking forward to them as one of the highlights of the day; but it was a much greater disappointment for all the families with children who had braved the gales to stay for the evening. However, nobody could have doubted the decision. It might have been dry, but it was certainly too breezy for fireworks.

We all gathered at the Riviera Restaurant at the appointed hour, filling the upstairs room to capacity. As we settled into the conversations, the meal, and the wonderful views of the floodlit city along the river, it became apparent that none of us had really noticed the absence of the fireworks. In fact, I think we were making so much noise that if there had been a change of heart and fireworks had started exploding over the river, we might not have noticed. Eventually, though, the clock started to tell and the group began to drift off to trains buses and homes after a most entertaining day – and certainly a much better day than one might have guessed from the omens …..

Brian and Denise Phillipson

INSPIRING THE NEXT GENERATION, BLOODHOUND

The Bloodhound Engineering Adventure provides a unique opportunity to share the entire project's information with schools, colleges and universities throughout the UK. Many of the current breed of engineers and scientists will have embarked on their careers as a result of being inspired by projects such as the Apollo moon landings, the development of the Concorde and the building of the Channel Tunnel. The BLOODHOUND SSC (supersonic car) projects number one aim however, is to replicate this surge of enthusiasm for science and engineering by inspiring the next generation to take up these professions. The shortage of young people taking up engineering is not just a UK problem; it is a developed world challenge, with the USA and Australia developing challenger cars, and many other European countries searching for the answer to this dearth of engineers and scientists! Let's not forget that it will be these young professionals that come up with the answers to the immense challenges the World faces such as energy, sustainability, and global warming etc.

The Bloodhound Project was announced to the World's media in October 2008 following an 18 month feasibility programme that assessed if it was possible to push the World Land Speed record to 1,000 mph (1,600kph). This is a staggering increase of 30% over the current record held by the British Thrust SSC team, many of whom are involved with the design and development of BLOODHOUND SSC. The big difference is that Bloodhound will have an education programme providing access to all the research, design, build and testing of the car that will be available to pupils from five years of age right through to university undergraduates. The Bloodhound Project will be around for at least the next three years, with the first high speed runs taking place at Hakskeen Pan in the Northern Cape South Africa during 2011. The search for a suitable desert or salt lake run site is also available on the website, making Bloodhound a truly cross curricular project that can be viewed by all schools and colleges in real time. The build centre location and the final aerodynamic shape of the car were announced recently following an intense phase of computational fluid dynamics research at the University of Swansea and the involvement of Intel who provided their super computer clusters to speed up the process. Again, these design iterations are available on the website and are being develop into classroom resources to support the new engineering diploma and GCSE subjects. The education strategy has been to work with existing initiatives including Primary Engineer, F1 in Schools, Greenpower, Science Made Simple, Young Engineers, and using current networks to deliver the project into education, at the same time providing coherence to the promotion of engineering.

There has been a big focus on working with key stage 2 & 3 pupils and almost 60,000 pupils were involved with the national K'Nex Challenge, where teams of two 10 year olds were given Bloodhound challenges to overcome with the national final held at the Duxford Aviation Museum. Primary Engineer has developed a terms worth of Bloodhound related science, technology and maths for use on interactive white boards. So the whole school can investigate exciting Bloodhound challenges as part of their normal school day. F1 in schools has just launched a new Bloodhound Class where the pupils design and make their CO2 powered cars using industry standard CAD/CAM packages. Bloodhound on the Road, delivered by Science Made Simple, is a travelling road show that visits schools and takes the pupils through the chemistry of the hybrid rocket and the challenge of pushing the car through the magical sound barrier. Coming on-line soon will be an education centre at the Bristol build site and Intel will be taking a lucky team of students to California for the International Science and Engineering fair in May 2010.

In the first year of operation of the Bloodhound Education Programme, over 3,300 schools and colleges have registered and used Bloodhound in the classroom, this equates to 11% of educational establishments throughout the UK. The project is now receiving requests from schools worldwide to become involved in an exciting engineering project that brings the STEM (science, technology, engineering and maths) subjects to life.

This article by Dave Rowley, Education Program Director of the Bloodhound SSC Project supported by the Royal Academy of Engineering is included in support of Gerald Heather, also on the education team, who was our Company's Stephenson Award winner in 2002, and the son of former Honorary Liveryman, Stanley Heather, who was involved closely with the founding of our Company.

FIONA AND NICHOLAS HAWLEY AWARD WINNING PAPER
Waste Vegetable Oil as an Alternative to Bitumen as a Binder for Asphalte
By Helen Bailey

Introduction

Typically, bitumens are used in road construction as binders for aggregates as they are water resistant, have good adhesive properties and, until recently, were cheap and available in vast quantities. Most adhesives and binders, including bituminous binders that are used for road building, are derived from fossil fuels. However, with petroleum reserves becoming depleted and the subsequent need to reduce fossil fuel usage, there is a drive to develop adhesives and binders from alternative sources, particularly those that are renewable. Renewable natural resources including sugars, triglyceride oils and proteins have been tested as alternative sources for producing adhesives and binders. It is therefore possible to use these renewable natural resources to produce monomers that can be synthesised into various alternative, sustainable binders for road construction [Airey *et al*, 2008].

It is believed [Calais and Clark, 2000] that oils of vegetable and animal origin, unlike fossil fuels, have the potential to be produced not only on a sustainable basis but also could be greenhouse gas neutral, or at the very least, emit substantially less greenhouse gases per unit energy than do any of the fossil fuels.

Waste or Used Vegetable Oil (UVO) refers to cooking oil that is produced from vegetable and nut sources (as opposed to animal fats and tallow) that has been used in food production and which is no longer viable for its intended use [SEPA, 2005].

Estimates for the annual generation of used vegetable oils (UVO) in the UK vary but are generally around 2.2 million tonnes [SEPA 2005]. Some of this waste is put to secondary use. A recent report highlighted three major industrial uses in the UK, biodiesel, combustion for power and specialist chemical products for the oleochemical industry [Kilpatrick, 2007]. However, applications are still not commercially available nationwide and much is still disposed of into specialist landfill.

Aggregate Industries believe that an alternative and more sustainable and environmental approach to the utilisation of such waste would be utilisation in asphalt mixtures.

This project researched and developed alternative uses for UVO as an asphalt rejuvenator and part bitumen replacement. Alternative binders and bitumen replacements are becoming increasingly important to the UK economy as bitumen availability and costs force Industry to look for ways to extend a limited and high cost hydrocarbon resource.

Laboratory studies and manufacturing trials have been carried out on asphalts using bitumen and used oil blends (Vegetex). This work has shown that partial substitution of bitumen with UVO can produce a wide range of standard binder grades and can act as a binder rejuvenator for reclaimed asphalt (RA).

UVO as bitumen replacement in asphalt mixtures

Part 1: Bitumen and Vegetable Oil blends (Vegetex)

Initially 40/60 penetration grade bitumens were used to produce bitumen/oil blends with 2-10 % by mass of UVO addition with subsequent binders concentrating on 10/20 pen hard-grades. Rheological characterisation of the blends were carried out using Penetration, Softening Point, Rotational Viscometer and Dynamic Shear Rheometer tests. Figure 1 shows the rheological properties of a 40/60 pen bitumen compared with a Vegetex blend for complex modulus and phase angle; the profiles are indistinguishable from each other. Asphalt mixture properties using these binders are summarised in table 1. Work showed that Vegetex blends can be produced without detrimental affect on resultant binders or mixtures.

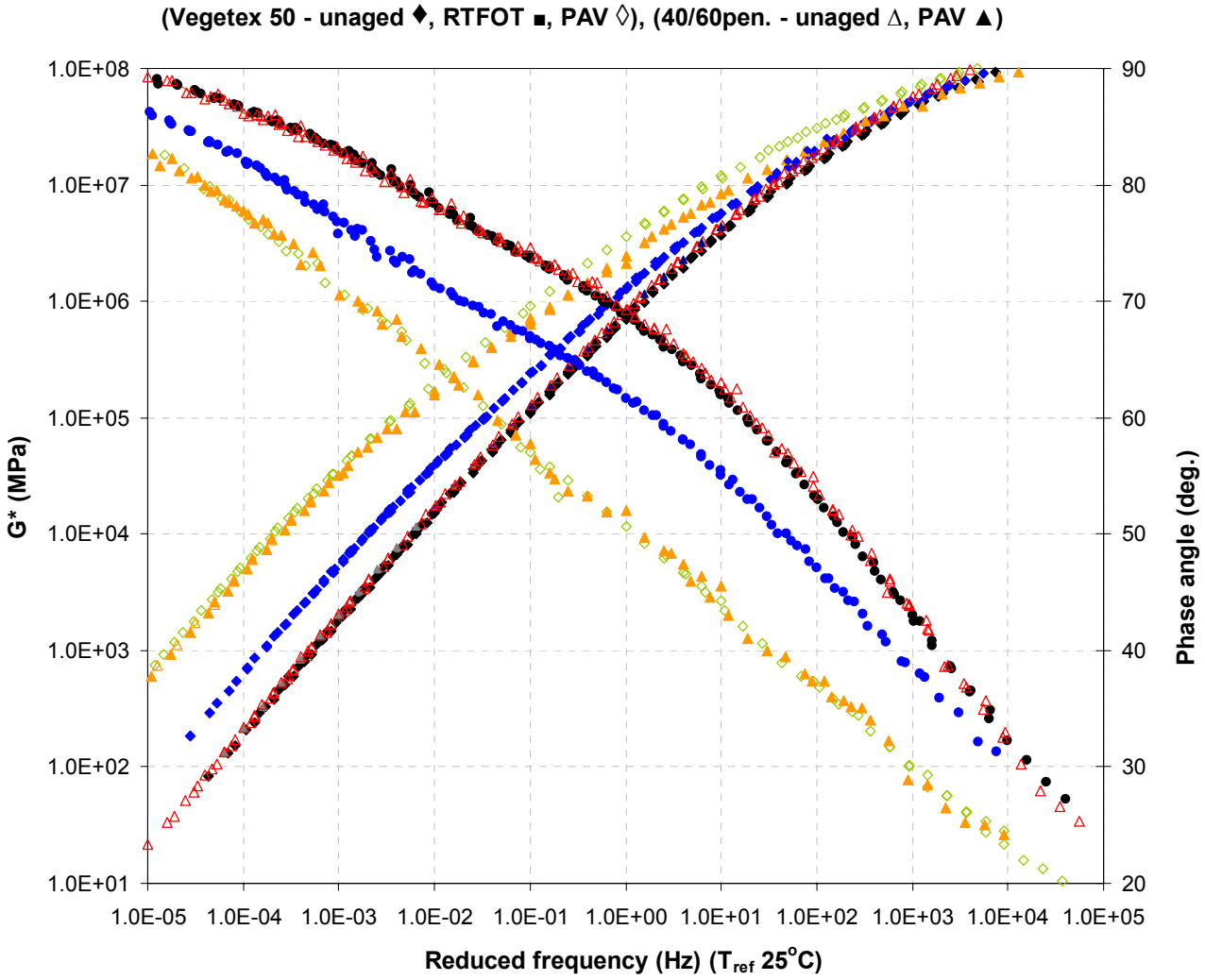


Figure 1: Complex Modulus, G*, and Phase Angle, δ, master curves at 25°C for 40/60pen and Vegetex 50

Table 1: Summary of mechanical properties of Vegetex mixtures

Test/Property	Control: 40/60 pen	Vegetex 50
Stiffness (ITSM), (MPa)	2550	2318
Short Term Oven Aging (STOA) (% change in stiffness)	+45	+48
STOA + Long Term Oven Aging (% change in stiffness)	+62	+65
Fatigue: Number of cycles at 500 microstrain	341	257
Fatigue: Microstrain at 1 million cycles	55	56
Water Sensitivity, % ITSR	78.8	85.9
Resistance to wheel tracking; 60°C Rut Depth at 45 mins (mm)	2.1	2.0
Resistance to wheel tracking; 60°C Rut Depth at 200 mins (mm)	2.9	3.2

Part 2: Vegetable oil as a rejuvenator in hot mix recycling

Preliminary experiments consisted of a quantity of uncompacted asphalt oven aged at 150°C for between 2 and 10hrs. After ageing, batches were roller compacted, cored and tested for volumetrics and stiffness (ITSM). Stiffness results are shown by the dashed trendline in Figure 2. Five additional batches were produced and aged in a loose state for 10 hours at 150ºC; each batch was rejuvenated with a known amount of UVO and mixed. Rejuvenated batches were compacted, cored and tested for stiffness; shown by solid trendline in figure 2. Results show how effective UVO can be as a rejuvenating agent when added during the hot mix recycling stage.

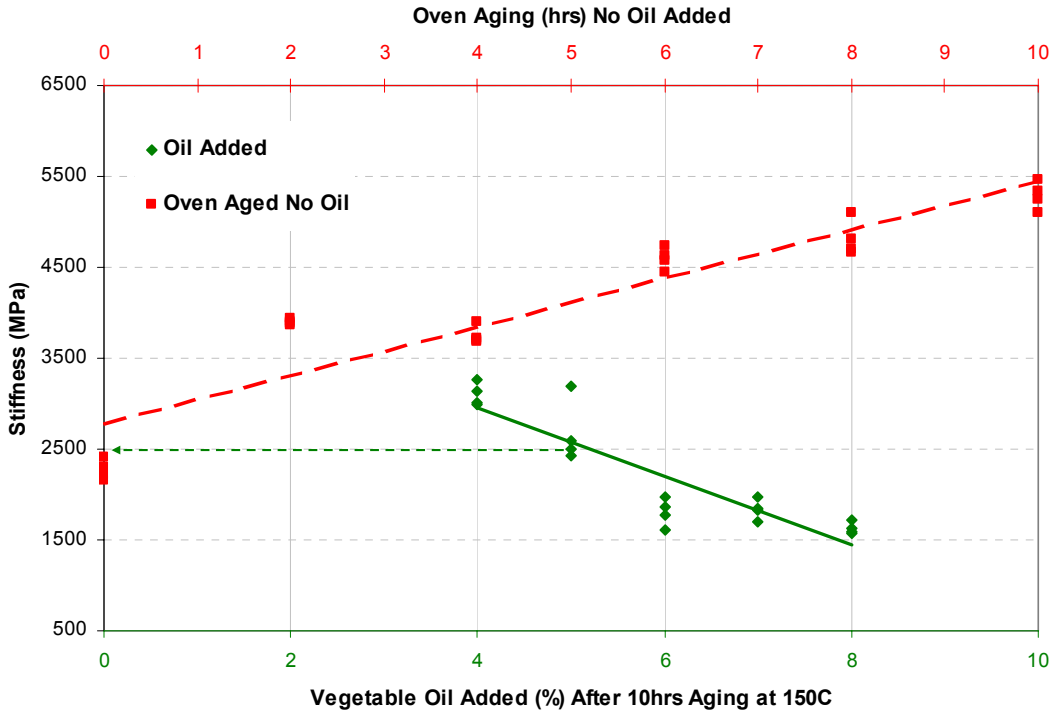


Figure 2: Rejuvenation of aged asphalt

Summary and Recommendations

Recovery of UVO for use as a bitumen replacement and rejuvenator of asphalt offers a number of technical and environmental gains:

- reduced dependency on landfill for disposal
- reduced CO2 for resultant asphalt mixture
- reduces reliance on expensive imported hydrocarbons thus helping the UK economy
- UVO is easily transported, handled and pumped hence there is no requirement for additional capital expenditure at an asphalt production facility.
- UVO can be stored at ambient temperatures reducing energy requirements for heating whilst also improving health and safety in terms of material handling at the plant.
- Incorporation of UVO can increase flexibility at the plant allowing a larger variety of standard materials to be produced with a minimum of tankage.
- UVO is fully compatible with asphalts so as not to hinder future development and recycling.

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CAROL SERVICE AND THAMES DINNER CRUISE, 17th December 2009

Twas on a bleak midwinter evening that the intrepid Company of Engineers gathered to celebrate Christmas at the Tower of London. A bitter east wind was blowing and there was sleet on the wind. Heads down, the Members trudged past the dour towers and into the Chapel Royal.

There a warm welcome awaited us from The Revd Roger Hall, delighted to see us return for our 15th Annual Carol Service. All the warmer, it soon became clear, since the boiler had been repaired that very morning. Led by our Chaplain, The Revd. Michael West and with the excellent voices of the Chapel Royal choir, we were soon to be heard in a heart-warming rendition of our favourite Carols. You could feel the angels bending near the earth and sense the gladness of men of old, mixed as they were with the modern wonderment of 'A Miracle', read by the Master's Lady and 'Creation', read by the Master. And the Chapel itself reflected back a warm, but powerful, majesty. Turning to leave, a plaque on the wall announced that in the Chapel are buried Norfolk and Suffolk, Essex and Northampton, Exeter and Durham – it seemed like every part of the kingdom had a part in that illustrious venue.

Once more out in the cold, we marvelled at the cosy timbered cottages, contrasting with the stark majesty of the White Tower, then scuttled down to the river front to where our boat awaited. Here the welcome was less warm, required as we were to queue in the bitter east wind. Indeed, if it had not been for our gallant (soon to be ex) Honorary Clerk, striding to the front to enquire why boarding was 15 minutes late, some of us were talking discontentedly of finding a more inviting hostelry. '15 minutes late! Why no' cried the captain with some heat – 'No more than 10! And on we piled.

Casting back reluctant glances at scarves and mufflers left downstairs, we emerged into the warm and welcoming lounge and were soon seated with ample good cheer. The wine was flowing and the conversation rising and the ship's crew bringing forth an excellent repast of festive soufflé and tender thyme roasted Guinea Fowl. At this point Table 23 would like to record an ardent thank you to those members of the Company who were not fortunate enough to overcome the inclement weather, for the extra helping of succulent Guinea Fowl that found its way to our table. The dessert did, it is true, raise some consternation – was a summer pudding really an appropriate dish for the season?

But by far the warmest point of the evening came when our illustrious Master rose to propose a vote of thanks to those present and, most particularly, to our (almost ex) Honorary Clerk. His exposition of the many virtues of our Clerk – welcoming, efficient, kindness, dignified, friendly – were strongly endorsed by the company present and the thanks was genuine and fulsome. In equal part, thanks were given to Margaret, for her selfless commitment to Company business and social activities. As a token of the appreciation of the Company for their seven years of service, the Master presented an elegant, glass and silver decanter engraved with the Company inscription of an iron bridge to our Honorary Clerk and an 18ct gold and natural gem necklace to his lady wife. With the warmth of the evening reflecting in shafts of gold and red light shimmering from the clear crystal of the decanter, we rose for the toast to 'The Worshipful Company of Engineers'.

But still we lingered in those final salutations. 'Oh'! cried the staff – 'we are half an hour late'. 'What?' we replied – 'Surely only 20 minutes?'. Then the Captain came over the PA system explaining that, due to the imminent expiry of his TfL ticket, he would be forced to set sail once more onto the icy, racing Thames. Not wishing to be cast adrift, we donned our coats and hurried once more out into the bitter night air. Dodging the hoodies (and here Ladies and Gentlemen you will be shocked to hear that some of the faces glancing back from under the hoods were none other than those whom so recently had shared such warmth) we scurried away into the night and the welcome warmth of the last train home.

Audrey Canning

Master's Speech and Appreciation

I'm sorry to interrupt your dinner conversations but I have it on the good authority of two very competent navigators on my table that we will be entering Iranian territorial waters in 15 minutes! and I have some important things to say to you, so I had better make a start!

Firstly, a very warm welcome to you all, especially our guests and among them the Chaplain of the Chapel Royal, Roger Hall, The Director of Music, Colm Carey and the members of the choir. We thank them for a wonderful Service this evening. Major General Keith Cima of the Royal Engineers who is Resident Governor of the Tower is unable to be with us this evening,

but we will be sending him our thanks tomorrow. We really are exceptionally privileged to be able to have our Carol Service in the Chapel Royal at the Tower.

Thank you to all of you who wore your **redr**UK badges and wore red for RedR to highlight our charity. As a result of your enthusiastic support we have raised £2400 for RedR at the Service.

Before I move onto a very important item of "any other business" I must do what it says in the programme and wish you all a very Happy Christmas and a healthy, successful and happy New Year.

It is now my pleasure to be able to express the thanks of the Company and its members to AVM Graham Skinner CBE RAF on the completion of seven years as our learned and gallant Clerk. It may be his retirement from the role of Clerk, but Graham has held the role on an honorary basis since this year's Common Hall when he was installed as a Court Assistant, so we look forward to his continuing involvement with the Company, which I personally hope will be in higher office, subject of course to future elections.

Since Graham took over as Clerk in January 2003 he has worked with 8 Masters, who no doubt all think that they should be credited with moving the Company forward. The truth, of course, is that it has been our Clerk who has made most of the difference over those years. Since 2003, our Company has become stronger, with membership considerably increased, the finances distinctly sounder, our Royal Charter granted and, with Graham's help, responsible for more open working of the Company, supported by our smoothly operating office, web-site and internet facilities, all to his credit.

Graham re-shaped our programme of social events, and with Margaret, has made the events even more friendly and welcoming. As Master, attending City events and those of other Livery Companies, I have been very impressed by how well-known and respected Graham is beyond our Company, and how much he has contributed to the outstanding reputation of the Engineers Company. And this has been thanks to his time as well as his talents. He has never missed a Court or committee meeting or a Company dinner or other key event during his tenure. Despite the "part-time" nature of the role of Clerk, Graham has been "on duty" pretty well continuously over those seven years.

So, Graham and Margaret, can I record a very big "thank you" on behalf of the Company and its members.

And our members' response to the news of Graham's retirement has been overwhelming. Substantially more members than are present this evening have sent me contributions towards gifts to mark the occasion and to express their thanks. I have a folder for Graham and Margaret including the names of contributors and a swathe of personal words of appreciation. In these, several words and phrases come up again and again: welcoming; friendly and efficient; huge personal effort; outstanding contribution; tact; organising skills; warm; kind; extremely successful, and "a really hard act to follow". They say it all.

The Presentations

To remind Graham of our appreciation, we have for him a Glass and Silver decanter/jug made by the distinguished Goldsmith and Silversmith

Martyn Pugh who is a Liveryman of the Worshipful Company of Goldsmiths. Martyn is renowned for his distinctive, elegant-yet-simple designs frequently combining silver with glass and/or rare wood using subtle lines and fine engineering. The long silver handle of this perfectly balanced piece is engraved to mark Graham's seven years as our Clerk while its neck carries a small reproduction of our Company's key symbol, Ironbridge, and our motto "Certare Ingenio". There is no neater or more apt way to sum up Graham's years as our Clerk than with this motto, which is translated as "To use one's skills to the best of one's abilities".

And for Margaret to enjoy at dinners when she is no longer on-duty, we have a necklace from Goldsmiths Fair made by a goldsmith with a Greek sounding name, Nicholas Yiannarakis. He describes it as of 18ct gold and natural gems which is amazingly apt as it has to be said that Margaret has been our *natural gem*, kindly and generously supporting Graham and all of us as The Clerk's Lady.
In addition we have a very substantial cheque which we hope they will use to enjoy the aftermath of seven very busy years.

So, on behalf of our members, and with Sylvia's help, I am delighted to make our presentation to Graham and Margaret.

PERSONALIA

The principle decision taken at the Court Meeting on 6th October was to appoint Wing Commander Tony Willenbruch as the new Clerk to the Company at the beginning of 2010. We welcome Tony, who was invested with the Livery in January, and look forward to working with him in the future. At the end of the Court meeting seven new Liverymen were invested and their photographs and their introductions to the Court given by the Clerk are given below.

After dinner two of the new Assistants, admitted to the Court in April, and the new Clerk gave presentations on their careers and these are also given.

Mr Iain Gilmour Gray BSc(Eng), MPhil, CEng, FRAeS

Iain Gray was awarded Honorary Doctorates in Engineering from both Bristol and Bath University after his first degree from Aberdeen University and is a Fellow of the Royal Aeronautical Society. His career has been in aircraft structural engineering especially related to Airbus wing design which culminated in becoming Managing Director of Airbus UK. He joined the Technology Strategy Board as Chief Executive in November 2007.

Mr Keith Stuart Williams BSc, CEng, FBCS, MIET, MS&RS

Keith Williams is a Computer science graduate who has been involved for 17 years in the field of safety and security critical systems with applications in aerospace, defence, transport and nuclear sectors. He is involved with CSE International and is presently Managing Director of Praxis High Integrity Systems Ltd. He is a fellow of the British Computer Society, and a member of the Institution of Engineering and Technology, and of the Safety and Reliability Society.

Dr Anthony Geoffrey Sheard DPhil, PhD, MBA, BEng, CEng, FIMechE, FRAeS, FASME, FCIBSE

Tony Sheard has doctorates from Oxford and Northampton, an MBA from Cranfield and a BEng from Liverpool. He has been principally interested in rotating equipment and new product development with two earlier periods in Rolls-Royce – first as the Chief Engineer (Allen Steam Turbines) and the second as Chief of Turbomachinery Engineering until 2001. Subsequently he has become Vice-President – Fan Technology in the Flakt Woods Group. He is a Fellow of the Institution of Mechanical Engineers, the Royal Aeronautical Society, the Chartered Institution of Building Services Engineers

Stephen Francis Wells BSc, CEng, FICE

Stephen Wells is a fellow of the Institution of Civil Engineers and of the Chartered Institution of Water and Environmental Management. He has had senior appointments in Biwater International, Wimpey Engineering and Construction and joined Costain in 2003 and has now become an Executive Director responsible for Group Strategy and Business Development – his principal interests are in the emerging markets of nuclear, waste and airports. He is already a liveryman with the Worshipful Company of Constructors and the Water Conservators.

EurIng Barry Charles Gasper MSc, FInstE, FIMechE

Barry Gasper has an MSc from Cranfield Institute of Technology and is a Fellow of the Energy Institute and the Institution of Mechanical Engineers. He has 33 years experience working in aerospace, electricity generation, scientific instrument development, defence ordnance safety and education. His principal engineering interests are structural and machine dynamics, condition monitoring assessments and structural integrity. He is presently Managing Director of Kent Engineering Services which is a small technical consultancy working for MOD.

Professor Michael Arthur Laughton BSc, PhD, DSc, CEng, FIET

Michael Laughton's degree from Toronto and Doctorates from London have underwritten his principal engineering interests of energy policy and engineering history. His own history has found him in Queen Mary College of London as Dean of Engineering and also visiting Professor at Imperial College. He has been a Parliamentary Specialist Advisor on Alternative Energy Technologies and Engineering Efficiency. He is now variously consulting in his field and is a Fellow of the Institution of Engineering and Technology. He is a liveryman with the Worshipful Company of Barbers.

John Herbert Lowe CEng, FIMechE, MCMI

John Lowe has had a long and strong professional association with the Ford Motor Company ranging from specialism in production management and control through to skills development in the industry, and more recently in setting up the Groups UK 'Corporate Social Responsibility' programme at the Dunton Technical Centre. Presently, he is a Trustee for the Science, Engineering and Technology Network and is keen to encourage young people into an engineering career. He is a Fellow of the Institution of Mechanical Engineers and is a Member of their Council.

Assistant Rear Admiral Neil Latham CBE, FIMarEST, MIMechE

Master, I am grateful for the opportunity to speak briefly this evening as a new member of the Court of Assistants.

My background as an engineer officer in the Royal Navy gave me experience and insight into what I would call technical leadership. At sea, an important aspect of this was developing people to achieve their full potential and to instil within them the highest professional standards for systems operation and maintenance. Later, in the Ministry of Defence, that leadership role was rather more complex and arguably more important for the long term well being of the Service, ensuring that proper recognition of technical matters was included in the formulation of policy and strategy; in my case, this was exercised through the formulation of operational requirements and reforming the arrangements for engineering and logistic support of the Fleet provided by the naval bases, dockyards and their industrial partners.

Education and training are closely allied to the notion of leadership that I have described, and I was therefore glad to influence this further though command of educational establishments: firstly, at HMS SULTAN, which expanded its remit during my tenure to become a tri-Service training organisation for electro-mechanical engineering apprentices for the REME and RAF ground trades as well as, of course, for the Royal Navy; and then, at what was the Royal Military College of Science at Shrivenham (now, of course, also a tri-Service institution, the Defence College of Management and Technology) I was able to generate a much greater emphasis on leadership matters at the postgraduate level, in part through the College's relationship and contract with Cranfield University.

And so, at the end of my naval career, it seemed a natural transition to move to the higher education sector full time, where I now occupy the position of Pro Vice-Chancellor at Kingston University, with particular responsibility for employer engagement – responding to the higher skills agenda that the government is pursuing, both for those already in work and the supply of new graduates into the professions.

It is so important to inspire young people about the merits of a career in engineering. We know how vital engineering is for the economy (about 12% of UK GDP is derived through manufacturing and at least double that if technical input to broader activity is counted) and how the challenges that our nation faces such the environment, energy security and an aging population, all require engineers to develop the solutions that society needs; but not everybody recognises that, and so it is another dimension of technical leadership to make sure that those messages are understood.

And so, finally, thinking about the aims of our Company and my roles in education and as a member of the Court of Assistants, I look forward to helping to lead the promotion and development of engineering for the benefit of all. Thank you for your attention.

Assistant Professor Andrew McNaughton BSc(Hon), FREng, FICE

I am Chief Engineer of High Speed Two, the company set up by Government in February this year to develop a high speed rail network in Great Britain and to engineer a specific first line from London to the West Midlands. But more of this in a moment.

When I left university in the late 1970s having read civil engineering, my ambition was to become the best structural engineer of my generation, designing great soaring bridges over estuaries and gorges. So what happened? I joined British Rail!

Now BR had the most wonderful training scheme which gave both very early technical and managerial responsibility. I would say that in respect of the latter it was second only to the Armed Forces which, culturally, it was perhaps not very different from at that time. So within a couple of years I was in charge of a large multi-disciplinary construction site leading civil, mechanical, electrical and architectural clerks of works. And after becoming chartered I found myself in a front line management role, maintaining a sizable chunk of the North East, with a team spanning from Engineers to a workforce many of whom were essentially illiterate. I was hooked!

I did get to design some bridges – little ones to enable electrification through to Norwich. And whilst doing that developed one of the guiding principles I still hold strongly; the merits of standardisation. Frustrated with the cost, time and quality compromises when every construction or maintenance task was a "one-off", I sought to create standard "production line" designs and processes, often halving the cost compared with the traditional approach. And so my career advanced.

Then came 1994 and the era when engineering became the vice which could not be mentioned in business circles. Many, many senior engineers retired or departed. I branched off into operational and then pure general management. I ended up Director of the Western Region for Railtrack, a place which had the (deserved) reputation, like the sheep which largely inhabited its further reaches, for regularly finding new and ingenious ways of expiring…

The Hatfield accident was the defining moment for the out-sourced, engineer-free, post-privatisation railway. Suddenly "engineering" became kind of essential

again and I was instantly appointed Chief Engineer (to be honest there weren't too many others still around!). I found myself signing to accept liability to raise around a thousand speed restrictions under my personal authority – because no-one else could, or would.

So, since the millennium I have been, first for Railtrack, then for Network Rail, steadily rebuilding a proper professional engineering function crossing all disciplines, and moving the GB railway out of the 19th at least towards the 21st century. I have been driving automation of examination and mechanisation of maintenance and construction, through creating a momentum for standardisation which had been utterly lost in the decade since the demise of British Rail.

I discovered another new field, Ergonomics – the (engineering) science of human performance, behaviour and human-technology interaction. I find designing for bio-mechanical-electrical systems with unvalidated, infinitely variable, control software (ie people) utterly fascinating! As an emergent subject area, this has led me into close working with the University of Nottingham, and developed another enthusiasm – helping to close the artificial divide between academia and industry. Through arranging (increasingly extended) secondments for academics into Network Rail, and vice versa, it has been rewarding to watch the development of mutual respect and understanding between them.

The need for a new generation of engineering leaders in my industry was urgent. By "leaders" I mean those comfortable with spanning and integrating the different engineering disciplines as well as having deeper knowledge in one. But more vitally, those who can do likewise across financial, legal and other business worlds and "mix it" at the most senior levels. I now get great pleasure from participating in the RAEng programmes, such as the Early Leadership Awards, to encourage the brightest of our current generation of engineering students to develop engineering management careers and not be diverted by the siren voices of other business sectors.

The point here is this: we don't need huge numbers of engineers capable of and determined to become tomorrow's business leaders, but we do want some and we do need the best. It is so important that we, the senior engineers of our generation, hold on to them and bring them on.

In February this year I left the role I loved and with much unfinished. Why? Because I believe High Speed Rail will be not just be a new transport system but one of the essential components of our economic

future. Over several decades the wealth generating and employment activity of GB has progressively moved to London and the South East – a place with insufficient basic services, infrastructure or space to keep growing as it has been doing. And it seems politicians are waking up to the novel concept that maybe this country has to *make things*, not just manipulate other peoples' money… I believe HS Rail is the only means of joining our great cities of the Midlands and North into a single combined economic entity capable of not only standing equal with London but competing in Europe. When each city is a half hour or less from its neighbours, they merge… I'm sorry, I can go on for hours on this but enough!

May I finish simply by saying, Master and colleagues, that I am greatly honoured to join the Court and I will do my best to contribute to the continuing well-being of this Company in the years to come.

The New Clerk, Liveryman Wing Commander Tony Willenbruch, MA, CEng, FIMechE, FRSA, FCMI, MRAeS

I am grateful for this opportunity to say how delighted and honoured I am to have been designated as successor to Air Marshal Skinner as Clerk to the Company. Through his commitment and dedication, the sterling support of his wife Margaret, and the unfailing experience and hard work of our outstanding Assistant Clerk, Stephen Grundy, Graham has made the role appear deceptively easy. His will be a hard act to follow.

While not underestimating the task, I look forward enormously to assisting our Master and his successors with their evolving strategy to take the Company forward into its second quarter century, maintaining it as a beacon for other, particularly Modern, livery companies. I look forward, too, to working with the Wardens and their committees as they put in place plans and activities at the tactical level to further those strategies and I see another of my most important tasks being to help my fellow Liverymen and Freemen gain as much value as possible from their association with this splendid Company.

Having originally studied metallurgy and materials science at Cambridge, I turned to engineering through a career in the Royal Air Force, completing a postgraduate diploma in aerosystems engineering during my early years in the Service. Having, throughout my 35 years as an Engineer Officer, kept up an active interest in my own professional institutions it seemed a natural step, on retirement in 2006, to take on the challenges of running smaller institutions providing professional development, education and membership services – albeit within the unfamiliar territory of the carpentry, joinery and wood science industries. Subsequently, I spent some time with the aerospace industry's trade association, working mainly with the Government's Technology Strategy Board – from which it is a great pleasure to see Iain Gray joining us today as a Liveryman.

Professional institutions have continued to play an important part in my spare time and I currently sit on the Aerospace Industries Board of the Institution of Mechanical Engineers and the Marketing and Policy Development Committee of the Chartered Management Institute; I also represent the latter institution on the Court of Imperial College London. I maintain other links with education through roles in university alumni organisations, as a Freeman of the Company of Educators and in the Honourable Society of Knights of The Round Table, a nearly 300-year old charity making awards to young people in a wide variety of educational organisations; I also act as Master of Ceremonies for their dinners.

I believe that these experiences, combined with those from the many other activities I undertake in Clubs, arts-, culture- and heritage-related societies, give me a background understanding of the running of small companies, membership organisations, charities and events for members in the contexts of engineering, education and the Livery movement which will help me deal effectively with the challenges that will face me as your new Clerk.

Tony Willenbruch