RCEA
(SUSSEX)

An Association for Retired Professional Engineers

NEWSLETTER March 2014

President's Message

Our last talk for the winter season was given on March 11th. For this we were fortunate to secure the services of an internationally acclaimed authority on the subject of fracking. The speaker, Richard Selley, a professor of Petroleum Exploration from Imperial College London, gave us the history and real facts surrounding Fracking with particular emphasis to the situation in West Sussex. Being a subject close to the hearts of many in West Sussex, for a multitude of reasons, it attracted a large audience of some 80 members and guests which is about double our average for the season. A diverse range of questions were posed after the talk which kept our speaker fully occupied for a full 2 hours!

Talks of this quality are best arranged from knowing people. Sometimes we get lucky, however, the old adage of "it's not what you know but who you know" really is alive and kicking. So I ask you all to rack your brains and think back to the days of employment and ask yourself whether any of your acquaintances could captivate our members with their knowledge and experiences. The committee does not have a monopoly for ideas or contacts. If contacted with a viable proposal they will make arrangements for any subsequent programme arrangements but please remember they will need a little more than "ring Fred on this number and I'm sure he will help you". Personal contacts are more likely to do favours for people they know rather than remote introductions.

The magnificent weather over the past couple of weeks really do make it look as though we have a summer to look forward to after all. To help us enjoy it we have arranged a visit per month up until the AGM in September. Details of how to join these visits and associated booking form can be found at the end of this newsletter. There are also two coffee mornings per month one being for members and partners.

So far this year we have enrolled six new members and two associates increasing our membership to 89. This may seem a little lower than in the recent past but we undertook an exercise this year to remove "lapsed"

members. This reduced our numbers a little but gave us a better idea of the overall situation. Our target is to get back to 100 plus and to aid this a "flyer" has been produced for distribution by all amongst those with an engineering background who are likely candidates. I would appreciate all our members making a concerted effort to help us fulfil this target if not by the AGM certainly by the end of the year.

My thanks again to the committee members who work tirelessly to ensure that we have a well organised, full and interesting programme of events throughout the year. But it must be reiterated that new blood is desperately needed. The average length of service for the current committee members is 8 years! which is too long and, to some extent, unfair. Just two new members for election at the September AGM would improve the situation enormously. So, come along everyone, lets have some nominations for next year. Any of the current committee is available to give guidance on what is involved. There are generally four committee meetings per year which will take up a morning The rest is down to what you feel you can bring to the party.

I trust that everyone will enjoy the summer and the events that are planned for the period up until our AGM in September. My regards to everyone and their families.

David Thomas

PROGRAMME OF EVENTS 2014

Tuesday	**8th April**	**Outing – Southwick House D-Day Wall and Map and R.M.P. Museum**
Thursday	**17th April**	**Coffee - at Spotted Cow, Angmering**
Thursday	**24th April**	**Coffee - with Partners at the Swallows Return, Worthing**
Tuesday	**13th May**	**Outing, Mary Rose Museum, Portsmouth Historic Dockyard**
Thursday	**15th May**	**Coffee - at Spotted Cow, Angmering**
Thursday	**29th May**	**Coffee - with Partners at the Swallows Return, Worthing**
Monday	**9th June**	**Outing -Worthing Wurlitzer Organ.**
Thursday	**19th June**	**Coffee - at Spotted Cow, Angmering**
Thursday	**26th June**	**Coffee - with Partners at the Swallows Return, Worthing**
Wednesday	**9th July**	**Outing, South Downs Planetarium, Chichester (Provisional date)**
Thursday	**17th July**	**Coffee - at Spotted Cow, Angmering**
Thursday	**31th July**	**Coffee - with Partners at the Swallows Return, Worthing**
Thursday	**21st August**	**Coffee - at Spotted Cow, Angmering**
Thursday	**28th August**	**Coffee - with Partners at the Swallows Return, Worthing**

Tuesday **16th September A.G.M and Talk 'Meccano to email a career in engineering'**

All Talks and Meetings will commence at 2.30 pm and be held in the Chichester Room, Field Place, Worthing; unless another venue or time is indicated.
Timings for visits and outings will be as printed in the detailed description of the activity. Coffee mornings commence at 10.30 a.m.

Website for the RCEA

For latest information, log into **www.rceasussex.org.uk**

New Members and Speakers for Talks

The RCEA needs new Members to ensure that we can continue as a thriving organisation. Please think of appropriate people you know and encourage them to join the RCEA.

We need more volunteers to give talks to us on Tuesday afternoons from September to April. Speakers from outside organisations are harder to find and often seek payments for the services. We are aware that many Members have the knowledge from their working careers to provide interesting talks. If you are willing to give a talk please let us know.

New Members

D. R. Nightingale, BSc, MSc, C.Eng, MIMechE
Bowfell, Hyde Street, Upper Beeding, Steyning, West Sussex, BN44 3TG
Dave & Pat 01903812847
drpnightingale@mypostoffice.co.uk
1964-66 Lucas Gas Turbine Equipment, 1971-2002 Ricardo Consulting Engineers
Interests: Mountaineering, Cycling, Cross Country and Athletics, Rebuilding 1936 MGTA and 1955 MGZA, Volunteer Ranger for South Downs National Park Authority

G. C. Woollard, ONC, HNC
18 St Lawrence Avenue, Worthing, West Sussex, BN14 7JF
George & Chris 01903523640
Georgewoollard1@hotmail.co.uk
Worked for 46 years in the electrical distribution industry up to 132kv covering maintenance, fault location, control and project management
*I*nterests: Driving for GuildCare 2 days per week, Masonary, Local Church

J. R. Andrews, C.Eng, MIMechE
84, Arlington Avenue, Goring by Sea, Worthing, BN12 4SR
John & Ann 01903368769
Janda75@tiscali.co.uk
1980-2000 John Brown Engineers & Constructor Ltd working on North Sea oil/gas platforms on compressors, generators, pumps, cranes and lifeboats
Interests: Lawn Bowls, Photography

R.D. Chapman, HND, I.Eng, MIMechE
12 Gerald Road, Worthing, West Sussex, BN11 5QQ
Robin & Barbara 07715825082
Robinchap5@yahoo.com
Apprenticeship-Mechanical Engineer, Depot Manager for plant hire company, Mechanical Engineer-Safety Systems for potentially hazardous areas
Interests; Keeping an allotment, Cycling, Gardening

R. F. Dawson, I.Eng, MIET, DMS, DIPM, MCIM
Bowerdene, 2, Cedar Close East, Aldwick, Bognor Regis, PO21 3BG
Richard & Linda 01243268922
Richard.f.dawson@btinternet.com
BT Telecom engineer, local & Trunk Exchange installation, Network Engineer Westminster, Marketing Engineer Customer Service Innovation UK
*In*terests: DIY, Gardening, Charity work (Prostate Cancer UK Support Work)

RCEA Insurance.

Members need to be aware that the insurance policy that the Association holds is solely for the protection for the assets and liabilities for the Association as an entity. The policy does not provide cover for personal injury or loss to individual members. Members therefore attend any of the Association's events at their own risk; although under some circumstances there may be some cover from the insurance arrangements of the venue owner.

Newsletter Entries

If you would like to provide an article for inclusion in a future newsletter it would be most welcome. We are always looking for new material. As a guide an article should be prepared as a Microsoft Word document, preferably in font size 10 and font style Times New Roman but this is not essential since all text will be 'standardised and formatted' when composing the newsletter. Pictures can be incorporated into the newsletter and are best supplied as JPEG images as separate files and separately from the text. (Word documents incorporating pictures can sometimes be very large files and are often not easy to manipulate into a suitable format for the newsletter.)

SOUTHERN RETIRED CHARTERED ENGINEERS

Events are arranged by the SRCE to which our members have a standing invitation.
We have not received a current list of events in time for this newsletter. We hope to include a list in the August newsletter.

Brief Detail – Talks, Outings and other activities April - August

Outing.

Tuesday 8th April 2014, 1.20 pm for visit at 1.30 pm. Southwick House D-Day Wall Map, used by the Allied Supreme Commander and the Royal Military Police Museum

The details for this outing were included in the December Newsletter (see **www.rceasussex.org.uk**).
The closing date is 28th March. If you receive this newsletter in time and wish to go, please contact Ray Wort. Reply Slip 1 is at the end of this newsletter.

Outing.

Tuesday 13th May 2014. Mary Rose Museum, Portsmouth Historic Dockyard.

11.30 – 12.30 Talk on engineering issues in the construction and operation of the new Museum. Members then free for lunch then visit the Museum. Cost £17.00. Payment required in advanced.

Contact: Randall Kier
Reply Slip 2 is at the end of this newsletter

Outing.

Monday 9th June
Visit to the Assembly Hall, Worthing & the Wurlitzer Organ.
Meet at 2.15 pm for a 2.30pm start. The Assembly Hall, Stoke Abbot Road. Worthing, BN11 1HQ

Through the kind consideration of The Worthing Theatres Department and The Sussex Theatre Organ Trust, Jim Buckland will provide a presentation that will in the first half of the afternoon and will explain-

The origin of the Wurlitzer Organ Company,
The history of the Worthing Wurlitzer,
The operation of the Wurlitzer Organ,
Its restoration and construction in the Assembly Hall

During the second half of the afternoon the organ will be demonstrated by Richard Hills FRCO who is the foremost artiste in the UK and who has a prestigious reputation internationally.

Contact: Randall Keir
Reply Slip 3 is at the end of this newsletter.

Outing.

Wednesday 9th July South Downs Planetarium, Chichester
Proposed visit at 10 am on Wednesday 9th July 2014

I have written to the Planetarium requesting a visit and I am awaiting a response. The RCEA had a very successful visit there about twelve years ago, the SCRE had one last year and we are hoping we can secure a visit this year.

The Planetarium was opened in 2001 and has a website www.southdowns.org.uk which is well worth a visit as it provides a great deal of background information. We are seeking what is known as an exclusive visit, not a public visit. This means that only we will be there and it enables the Planetarium to put on a bespoke show for us to meet our agreed wishes.

If you would be interested in visiting the Planetarium would you please send me the reply slip or email me with your details and I will keep you up to date on progress including the cost. I would estimate the cost would be about £8 to £10 to include an introductory talk, a show and coffee.

Contact: Glyn Mathias.
Reply Slip 4 is at the end of this newsletter

Reports

Talk:

Tuesday January 14th 2014

'Thomas Brassey- Railway Builder' by David Jones, RCEA

This illustrated talk outlined the life of the unsung railway contractor Thomas Brassey, a phenomenal organiser and leader This illustrated talk outlined the life of the unsung railway contractor Thomas Brassey, a of men, who never swore or raised his voice. He is credited with the building of 2061 miles of railway in the UK, one third of the total mileage, and a further 4462 miles overseas as far away as Argentina and Australia, about one twelfth of the world's mileage. At one time his workforce was 45,000 men.

Born on 7 November 1805 at Manor Farm, Buerton near Aldford, Cheshire, he later attended Mr. Harling's School in Chester then in 1821, aged 16 years joined William Lawton, Land surveyor and Agent in Birkenhead subsequently becoming a partner in 1826. He was articled to build a small bridge at Saughall Massie in the Wirral, but George Stephenson who had contacted him for stone from Storeton quarry to repair the Sankey Viaduct on the 1830 Liverpool Manchester line, suggested he move into railway work. He introduced him to Joseph Locke, his pupil and engineer for the Grand Junction Railway who persuaded him to tender for building the Penkridge Viaduct and 10 miles of railway line, which marked the beginning of the association between the two men.

In 1837 Locke and Brassey worked on the London – Southampton Railway, which had already been started by Francis Giles, engineer for the Basingstoke Canal, but he used small contractors for each section which caused difficulties. The line opened throughout in 1840 by which time it had become the LSWR. An extension to Gosport encountered problems at Fareham due to the unstable ground and almost broke Brassey.

In 1841 Joseph Locke was engaged as engineer in France on the Paris to Rouen line so brought in Brassey, partnered with brothers William and Edward McKenzie, another firm of contractors. The locomotives for the line were built by William Buddicon, previously with the Grand Junction Railway at Crewe, and constructed at a new factory in Rouen. One of the Buddicom engines is preserved at the railway museum in Mulhouse. The onward route to Le Harve included the Barentin Viaduct, built 1845, where there was a problem with the local lime cement causing a collapse on 10 January 1846. It was rebuilt at Brassey's own expense in six months with better cement of his own choosing, opened in 1847 and is still in use today.

Further lines in England included the Caledonian Railway – Section One, later known as the Lancaster to Carlisle Railway which included Shap Fell where 250,000 cubic yards of rock had to be blasted away, requiring the use of 9,600 men and 800 horses. George Stephenson favoured the long coastal route, but Joseph Locke got his own way with his direct 70 mile route over the hills. The first sod was cut July 1844 at 914 feet altitude, with the line opening on 15 Dec 1846. Chester Station was opened in 1848, where there are now three plaques commemorating Thomas Brassey.

The Great Northern Railway main line from London to Peterborough was largely Brassey's own work, which included the impressive Welwyn viaduct designed by William Cubitt and opened by Queen Victoria in August 1850. The cast iron bridge at Peterborough, designed by Joseph Cubitt, was also opened in August 1850 and is still in daily use. Brassey received a Testimonial Salver shown at the Great Exhibition in 1851.

In 1853 Brassey decided to lay his own speculative 32 mile Portsmouth Direct Railway from the then terminus at Godalming to Havant which trimmed the existing route to Portsmouth by 30 miles. Completed by 1858 it was first offered to the SER, but eventually purchased by the LSWR. This resulted in a dispute between the two existing lines so the LBSCR blocked the entrance to Havant using a locomotive chained to the track on January 1 1859, when the LSWR started to run trains. A court enquiry followed but only delayed the opening until 24 January 1859.

The largest contract was jointly with Samuel Morton Peto and Edward Ladd Betts for the Grand Trunk Railway of Canada, 539 miles along the St. Lawrence from Quebec to Toronto including the Victoria Bridge at Montreal, designed by Robert Stephenson and completed December 19 1859. All the materials including locomotives were made in Birkenhead at the 1853-built Canada Works of Thomas Brassey and Co.

In late 1854, having heard of the difficulties in the Crimea, especially following the Charge of the Light Brigade fiasco on 25 October and the hard winter, Brassey teamed up again with Peto and Betts and offered to build a railway from Balaclava to the siege lines. This was gratefully accepted by the Government and Generals, so in early February 1855 23 ships with equipment and navvies reached Balaclava harbour and 20 miles of the railway was constructed within six weeks, the mileage being doubled by the time Sevastopol was abandoned by the Russians in September 1855.

Further railways included the 112 mile Eastern Bengal Railway, Inverness and Aberdeen Junction Railway and the 66 mile Bilbao and Miranda railway together with Salisbury Station and completion of the Mount Cenis tunnel in Italy. After the Maremma to Leghorn (now Livorno) Railway of 138 miles in Italy and Jutland Railway of 270 miles in Denmark, he diversified to help build part of the London sewer system for Joseph Bazalgette. Then followed the Mauritius Railway of 64 miles and the line from Ringwood to Christchurch, plus in 1864 the East London Line and the Dehli Railway. Brassey and his partners then bought 'The Great Eastern' steamship of I. K. Brunel, launched in 1858, to lay the successful continuous transatlantic cable in 1864, as the short-lived cable of 1858, which was joined in the middle, broke.

In 1866, the Cracow to Lemberg Railway, now Krakov to Lvov, was built at the height of the Prussian assault on the Austro-Hungarian Empire. The men were owed their wages, so agent Victor Ofenheim persuaded an elderly engine driver to go flat out through the battle lines to deliver bags of cash to the men. Emperor Franz Joseph of Austria later asked "Who is this Mr. Brassey for whom men would risk their lives", and presented him a medal, 'The Cross of the Iron Crown'.

Also in 1866, the collapse of the Overend, Gurney Bank caused the bankruptcy of Peto, Betts and Crampton which affected Brassey as he had to finish off the joint contracts on his own. He became ill whilst living in St. Leonards-on-Sea and was transferred to the Royal Victoria Hotel on the sea front where he died aged 65 on the 8th December 1870. His wife Maria Farringdon died, also aged 65, on the 3rd January 1877, and both are buried at St. Laurence churchyard, Catsfield, East Sussex. A comprehensive display and a bust of Thomas Brassey can be seen in Hastings Museum, and there is a chapel to his memory in Chester Cathedral. He left £5.2 million to his three surviving sons who became MPs or country squires.

Talk:

Tuesday 11th February
South Korea. A cultural perspective, viewed through their rolling stock.

To the man in the street, Korea is a place that not a lot is known about. However, we are often urged to emulate the South Korean's in the workplace and with the education of our children. Superficially there are many aspects of Korean life that are familiar to those of us brought up in the UK in the 50s, 60s and 70s. Although the role of women in society along with attitudes to safety in the workplace have improved in the UK, some of us may lament changes in other areas e.g. respect for others particularly the older members of society.

The rail network in Korea is very comprehensive and easy to use. With an increasing network of high-speed lines it was my preferred mode of transport. Unlike the UK the Koreans seem to be able to develop their network without weekend closures and/or diversions. Some of the rolling stock has a familiar look with TGVs and locomotives built by European/Korean partnerships. Unlike the UK you are not considered weird if you photograph trains.

Having spent two years in Korea my favourite adjective that sums up Korea and Korean society is “crazy”. Crazy buildings, tower blocks dominate the townscapes. A crazy education system where children from two to eighteen spend 10-14 hours a day in schools, cramming colleges and doing homework with no time to play. A crazy Confucius culture, where age and seniority appears to takes precedence over innovation by young graduates in industry. One can just go on with examples but that would be just crazy!

Philip Dee (디 필립)

Changwon station, May 2010, 6 months before the start of direct electric trains to Seoul with no closures or diversions

A holiday snap at Jeondongjin in front of the express to Seoul

A protest by the workforce

Women return to the workplace when their families have grown up, often in unskilled work

Entertainment on the train from Daegu to Yeonju. Karaoke is optional

The Koreans don't understand irony

Visit:

Wednesday 5th March Brookhurst Wood household waste treatment facility, Horsham.

Some members will recall that we visited this facility in July 2012 whilst it was under construction, and this return visit had been requested to see the plant once construction had been completed.

Our party of 30 members and guests were able to both learn of the background to this project via a presentation by the operator, BIFFA, to watch some of the plant operating on video, and to see the main waste processing area from the comfort and safety of a carpeted viewing gallery – a far cry from the muddy site conditions that we encountered during the construction phase. Unfortunately the majority of the plant in the main processing hall was undergoing maintenance at the time of our visit, although the grab and control room were operational.

This site has been used for landfill since 1980, but councils are under severe government pressure to reduce the amount of waste going to landfill by increasing recycling rates. As an additional inducement landfill tax is constantly being increased, and is currently £72 per ton.

Last year West Sussex produced 374,773 tons of household waste and recycled 43% of it. Some of the nonrecycled waste is consumed in the incinerator at Newhaven, some is now being processed in this new waste treatment facility, and some is still going to landfill just a short distance from the new plant. However this adjacent landfill site is due to be closed by 2016 and we were shown how the 'mound' will be capped and planted with trees. The pipes that are embedded within the 'mound' which remove the methane gas will remain for up to 60 years.

This plant processes only non-hazardous 'black bag' waste, which is delivered to site by road and initially loaded via a grab into a mechanical shredder to reduce the maximum particle size down to 300mm. **Picture 1** shows the grab loading waste into the shredder. The shredder teeth can be damaged by very large hard objects in the incoming waste stream, and we learnt of a few occasions when gas bottles had been put into household dustbins and had been caught up in the shredder teeth!

Following shredding, the waste stream enters the main processing hall where any metals are removed by magnetic and eddy current separators, light materials such as paper and plastic by air blast and heavy materials such as stones, concrete, by gravity. **Picture 2** shows the main processing hall.

The remaining waste stream, mainly food waste, is sent to one of 6 Anaerobic Digesters (**picture 3**) where it is heated and remains for 14-18 days generating **Biogas** which is used as feedstock for an on-site CHP unit. The material remaining in the Anaerobic Digester after this is referred to as **Digestate**, a compost-like material, which is used to cover the adjacent landfill 'mound' as an alternative to bought-in top soil. Any surplus Digestate is sold.

The paper and plastics is referred to as **Refuse Derived Fuel** and is currently going to landfill, but will ultimately be sent off site for incineration once contracts have been agreed. Currently this fuel is capable of providing 12M joules per Kg.

Residues (what is left after the above process) goes to landfill.

The on-site CHP unit produces a maximum of 4.2MW of electricity and a similar quantity of heat. Whilst the plant is running (currently daytime only) it requires approximately 5MW of electricity, making the facility a net importer of electricity during the day and a net exporter during the night. The point was made that it would seem far better to operate the plant at night so that a better price could be obtained for the electricity during the day, but Biffa explained that there were significant environmental objections from nearby residents to nighttime operation.

The CHP heat output is used in the Anaerobic Digesters and for office heating and hot water.

Picture 1

Grab loading waste into the shredder to reduce the maximum particle size down to 300mm.

Picture 3
Anaerobic Digesters where the waste stream, which is mainly food waste, is heated and remains for 14-18 days generating Biogas. This is used as feedstock for an on-site CHP unit.

Picture 2
Main Processing Hall where the waste stream enters and any metals are removed by magnetic and eddy current separators. Light materials, such as paper and plastic are removed by air blast and heavy materials such as stones, concrete, by gravity.

Talk:

Tuesday 11th March

Fracking shale gas: What on Earth is that all about?" by Professor Richard Selley

When we arranged this talk we were aware that it was likely to be a popular topic so we encouraged members to bring a colleague (or two) along. Our members did not disappoint, and a total of 77 members and guests heard an excellent and entertaining presentation from our speaker, Professor Richard Selley. Following the usual break for refreshments, we then had a very lively question and answer session.
Professor Selley began by outlining the history of fracking, which has its origins in the USA in 1860 (yes over 150 years ago) when explosives were used to release gases trapped in underground shales. In fact the history of shale gas extraction goes back even further, we were shown pictures of a monument in New York State dated 1821 where gas was being produced from naturally fractured shale. One well would supply the needs of a small village or a hospital and had a lifetime of about 30 years. The USA clearly has a lot of experience extracting shale gas by fracking and has drilled over 2 million wells.

Within the UK we have significant experience in oil and gas production from the north sea, and some 2000 onshore oil wells, one of the earliest being at Netherfield, near Hastings, which was drilled in 1875. Furthermore the UK has many years of experience of regulating the onshore oil and gas industry nationally, and one of the most tightly regulated regimes in the world.

Our speaker then described the process of fracking in detail. Shale is fissile rock that is formed by the consolidation of clay, mud, or silt. It has a finely stratified or laminated structure, and is composed of minerals essentially unaltered since deposition. The shale deposits that are of interest, i.e. those holding exploitable gas deposits, are located some 1500m or more below ground level. Like other oil and gas exploration or production, a bore hole approximately 1m in diameter is drilled and several stages of metal pipes ("casings") are set in concrete within the well, to seal it and prevent contamination of surrounding groundwater. A well for shale gas will usually go down vertically to the shale layer and then run horizontally along it. For shale oil or gas, the rock is then fractured by injecting liquid at high pressure, an established technique for conventional oil and gas, but used more intensively for shale. Small particles (usually sand) are pumped into the fractures to keep them open when the pressure is released, so that the gas can flow into the well. The 'liquid' referred to above is 9899% water and sand, with a small quantity of chemicals added to improve efficiency, for example to reduce friction. In the UK, operators must show the Environment Agency that all such chemicals are non-hazardous in their intended application. Once the rock is fractured, some of the fluid returns to the surface, where it is sealed in containers before treatment. The gas or oil can then flow through the well to surface operations which separate and process the gas or oil. If oil is recovered, it will be taken to an oil refinery or petrochemical plant. Resources (the quantity of gas/oil that is in the ground) is quite different from Reserves (the quantity that we can actually extract) and economics dictate whether a test drilling will ultimately lead to production.

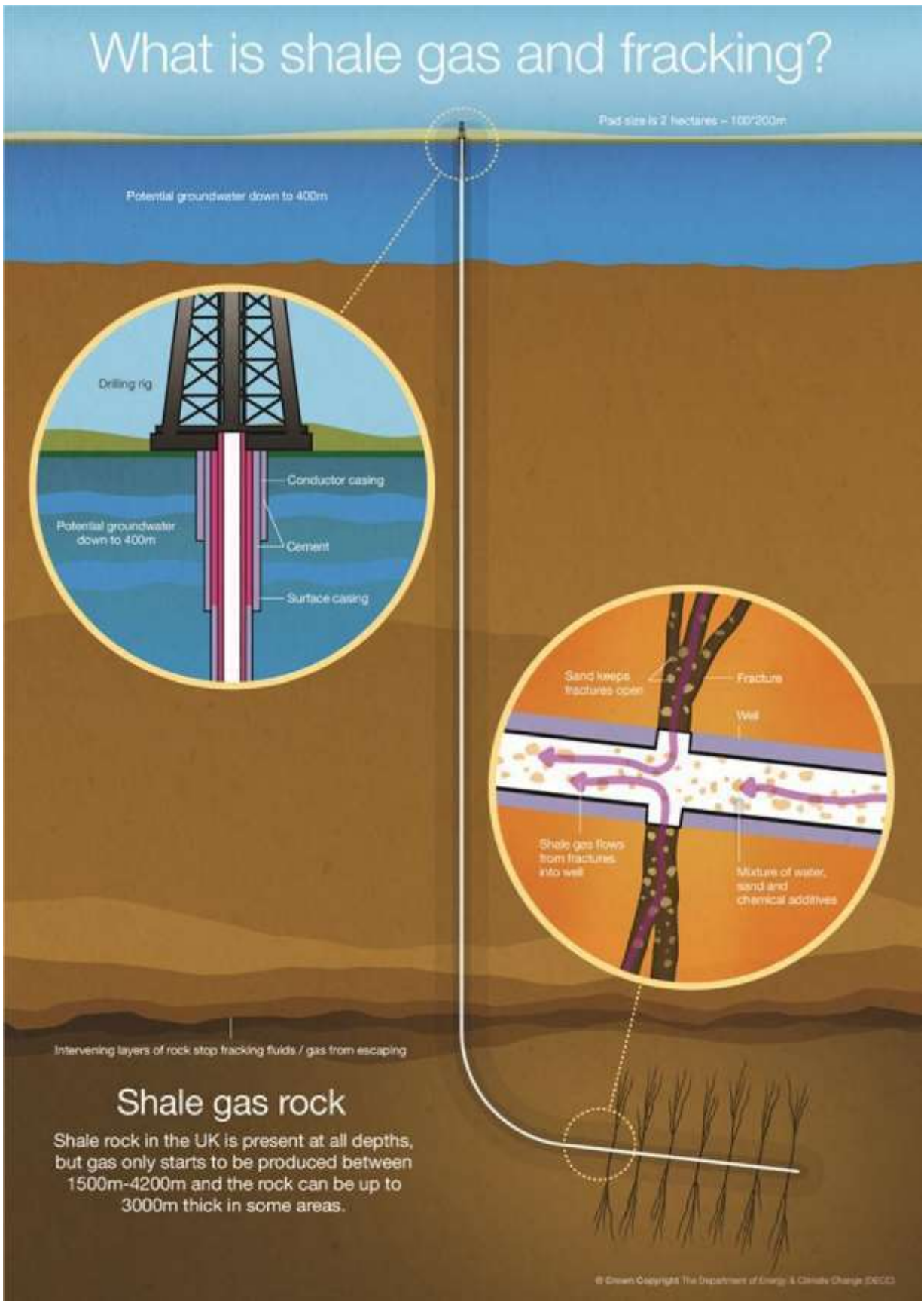
Professor Selley then discussed the current situation in the UK, in particular referring to some of the objections raised in the popular press:-

Impact on surface water – recycling water used within the extraction process will reduce any impact Impact of additional emissions of methane and CO2 – reduced by carbon capture

Earthquakes, of which two have so far been attributed to fracking within the UK, neither above 2.3 in magnitude on the Richter scale – each day there are 3-4 earthquakes within the UK, often the result of collapsing mines

Contamination of underground aquifers – aquifers rarely occur below 300m and all onshore wells drilled in the UK have to be fitted with sealed steel casings

In conclusion Professor Selley explained how developments in horizontal drilling techniques, improved hydraulic fracturing technology and progress in imaging technology using geo-phones will ensure that fracking in the UK would be capable of providing one of the solutions to our future energy needs as our reliance on coal and North Sea oil declines.


What is shale gas and fracking?
Pad size is 2 hectares – 100*200m
Potential groundwater down to 400m
Drilling rig
Conductor casing
Potential groundwater down to 400m
Cement
Surface casing
Sand keeps fractures open
Fracture
Well
Shale gas flows from fractures into well
Mixture of water, sand and chemical additives
Intervening layers of rock stop fracking fluids / gas from escaping
Shale gas rock
Shale rock in the UK is present at all depths, but gas only starts to be produced between 1500m-4200m and the rock can be up to 3000m thick in some areas.

REPLY SLIP 1

To Ray Wort, 11 Roberts Marine Mansions, West Parade, Worthing, BN11 5EB

E-mail raywort@btinternet.com

I would like to register to attend the **Outing to Southwick House D-Day Wall Map and the Royal Military Police Museum, on Tuesday 8th April 2013, assembling at 1.20 pm for the visit to commence at 1.30 pm.**

Full Name (Member)…… Telephone……..

Address……. e-mail…….……

……..

…….....

Full name of guest/s or visitor/s…….……

Car Registration Number……..

Have you and your guests Photo ID? Do you need Disabled Parking? Do YES / NO YES / NO **Cost £2.00 per person (cash) to be collected at the assembly point before admission to the site**

Latest date for applications by **post, or e-mail 28th March 2014**

REPLY SLIP 2

To:

Randall Keir, 16, Shirley Close, Rustington, West Sussex. BN16 2EG Telephone 01903 785952 or email randallkeir@btinternet.com

Please reserve me ……. places to attend the **Outing on Tuesday 13th May at 11:15am to the Mary Rose Museum, Portsmouth Naval Base.**

Full name:……(Block capitals)

Address……

……

……

……..

Phone No……. e-mail address ……..

Cheque enclosed for £……. at £17:00 per person **(non-refundable)**, made out to the RCEA.

Applications by 25th April 2014

REPLY SLIP 3

To:

Randall Keir, 16, Shirley Close, Rustington, West Sussex. BN16 2EG

Telephone 01903 785952 or email randallkeir@btinternet.com

Please reserve me ……. places to attend the **Outing on Monday 9th June at 2:15pm to the Wurlitzer Organ, The Assembly Hall, Stoke Abbot Road, Worthing.**

Full name:……(Block capitals)

Address……

……

……

……..

Phone No……. e-mail address ……..

Applications by 30th May 2014

REPLY SLIP 4

To: Glyn Mathais, 16, Tamarisk Way, East Preston, Littlehampton. email: glyn.mathias@btinternet.com Tel: 01903 859191

Possible outing to South Downs Planetarium - date and time to be confirmed.

I am interested in attending a visit to the Planetarium; please provide me with details when available.

Name .....

Address .....

.....

email:

.....

Likely number of attendees (if known) .....

Please email or return the slip.