IESF
SOCIÉTÉ DES INGÉNIEURS ET SCIENTIFIQUES DE FRANCE

Newsletter

British Section
www.iesf.co.uk

Issue 29: December 2020

Covid-19

Like it or not, this year has been dominated by the Covid-19 pandemic. Not a single one of us has been spared its effects. We have all had to live differently, and some of us have felt the full force of the disease through the tragic loss of family members and friends. The President and Council Members sincerely hope you are not in the latter category, but if you are they extend their deepest sympathy,

On a positive note, hopefully one of the vaccines will give us confidence to resume normal life and, in particular, to meet up at a future IESF lecture and dinner in 2021. Keep safe!

AGM and President's Lecture 27th January 2020

Richard Coackley opened the AGM with a summary of his year as President. The Centenary year of the British Section acted as the predominant theme of his presidency culminating in the Centenary Dinner in London and the autumn voyage to Paris. Richard thanked the Council members who had helped ensure that all the events during the year had proceeded without a hitch. He particularly mentioned Ray and Liz Jefferson together with John Beck for the production of the excellent centenary anniversary book, 'L'Entente Cordiale'.

Richard's final act as President was to hand over the IESF Jewel of Office to the incoming president, Dr David Hughes.

David Hughes receiving the IESF Jewel of Office

Inaugural Address by David Hughes ~ Engineering in Medicine

David Hughes commenced his presidential address by thanking IESF for stimulating his research into Engineering in Medicine and for his wife, Jane, for giving him such great support and inspiration.

Addenbrookes Hospital bears a mural by Quentin Blake that commemorates some of the moments in Cambridge University's history. Commencing with the flight of Oxford scholars over 800 years ago, the appointment of Dorothy Garrod to the Chair of Archaeology 9 years before the university admitted women as full members, to Rosalind Franklin for her part in unravelling the Double Helix and towards the end it celebrates Frank Whittle and his jet engine.

Part of Quentin Blake's Mural

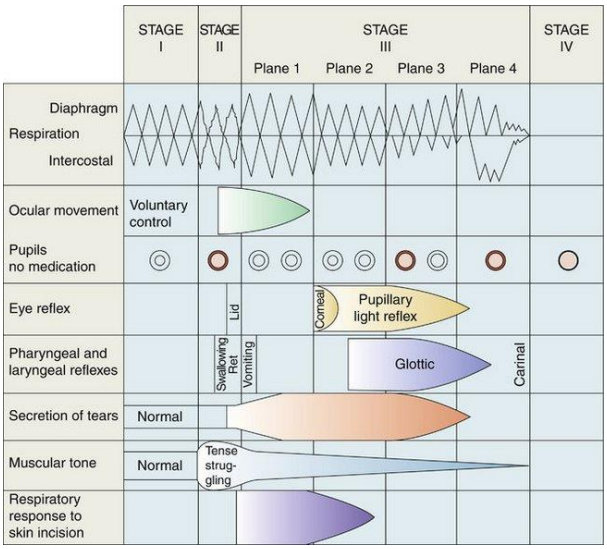
On David's Specialty, William Morris of Morris Cars fame endowed the UK's first Chair in Anaesthetics at Oxford but his offer to endow a College of Engineering was declined by the University!

Once the effects of anaesthesia were known, the method of administrating needed to be developed. John Snow gave chloroform to Queen Victoria to ease her labour pains, whilst Joseph Clover designed a vaporiser and Louis Ombredanne, a French surgeon made a better one. The latter's vaporiser originally had a bag made from a cow's intestine.

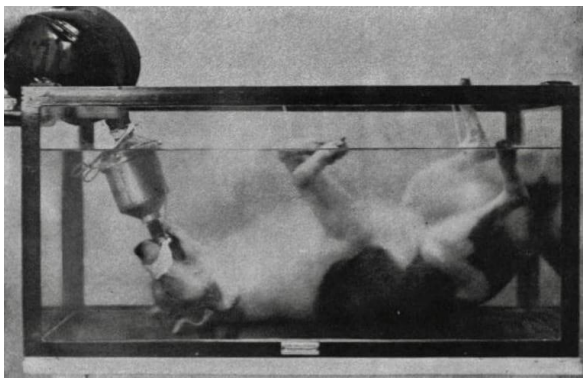
At the beginning of the 20th Century, Augustus Desire Waller, born in Paris, postulated that occasional sudden deaths associated with using chloroform were due to overdosing. This resulted in the introduction of machines to deliver controlled amounts of gases, including Nitrous Oxide, to patients.

An American Army doctor, Arthur Guedel, made important contributions to anaesthetics, including a training chart to describe the various stages of anaesthesia.

He demonstrated his inflatable cuff around a tube in the windpipe by submerging his dog "Airway" in a tank of water. Obviously after anaesthetising him!



Four Stages of Deepening Anaesthesia


"The Dunked Dog" demonstration

The management of a patient's airway is still a core anaesthetic skill.

The use of greenhouse gases in anaesthetics has a consequence on global warming, which the NHS has a long-term plan to reduce. The Global Warming Potential (GWP) for CO_2 is equal to one.

Anaesthetic Greenhouse Gases

Agent	GWP	CO_2e kg	Bottle size
N_2O	298	5015	G
Sevoflurane	130	44	250ml
Desflurane	2540	886	240ml

The table above shows the GWP for modern anaesthetic gases that are

exhaled automatically to the atmosphere by the patient.

The latest anaesthetic machines have provision for total intravenous anaesthetic (TIVA) doing away with the use of greenhouse gases. However, whilst TIVA is an option, accidental patient awareness during an operation is more likely if no gases are used.

The largest single hospital speciality is anaesthetics. This work carries a heavy burden of stress but there is still little or no funding for Clinical Psychologists to provide support.

David ended his lecture on a good news story. In 2018, a boys' football team was lost in a flooded cave system in Thailand. An expert diving pair, Dr Richard Harris, Anaesthetist and Craig Cullen, a Veterinary Surgeon, were called in to manage the extraction. They trained the other divers how to anaesthetise the boys before bringing them out through the cave system. The journey took 3-4 hours during which time the anaesthetic was topped-up at 2-3 staging points along the route.

Dr Harris was awarded the Pask Medal for his skill and bravery in the rescue, He and Craig Cullen, were voted Australians of the Year.

IESF Ski Group – February 2020

This year seventeen members and friends skied at Belle Plagne in the French Alps, staying in the very comfortable Chalet Hotel Turquoise situated on one of the pistes. The nearest lift was just a short walk/ski away.

The weather varied during the week including days of bright sunshine and occasional snow days, known by some as bridge days. An excellent restaurant was selected for the evening dinner out. This allowed us all to celebrate Michael Leeming's birthday and eight years of IESF Ski Trips.

Three of the intrepid IESF skiers

High Frequency Waveforms in Anaesthesia and Pain Medicine (Virtual Lecture online ~ 13th Oct 2020)

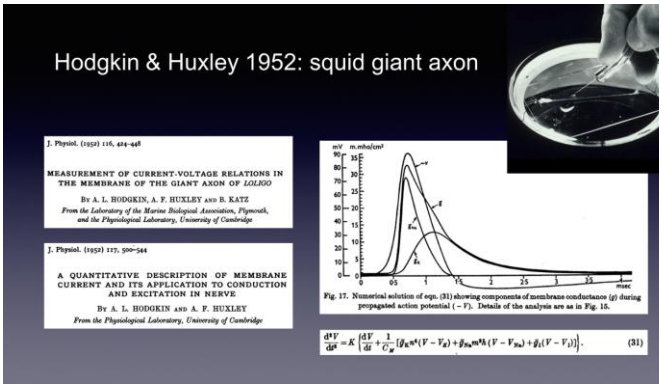
Dr Mike Hudspith first met our president, David Hughes, in 1993 when he was an anaesthetic trainee and David a consultant in pain medicine. Consequently, Mike credits (or blames) David for his subsequent career path in pain medicine and this lecture on radio frequency or high frequency in anaesthesia.

As Nikola Tesla (not of the car fame!) commented …"If you want to find the secrets of the universe, think in terms of energy, frequency and vibration"… although he was probably not considering the human brain!

As an Anaesthetist, Mike defined his role as manipulating consciousness and treating pain which raises some fundamental questions such as how is consciousness generated and can it be measured? He took us through a history of conscious experience, anaesthesia and pain medicine based on the consideration of nerve cells as excitable cells, as oscillators and how

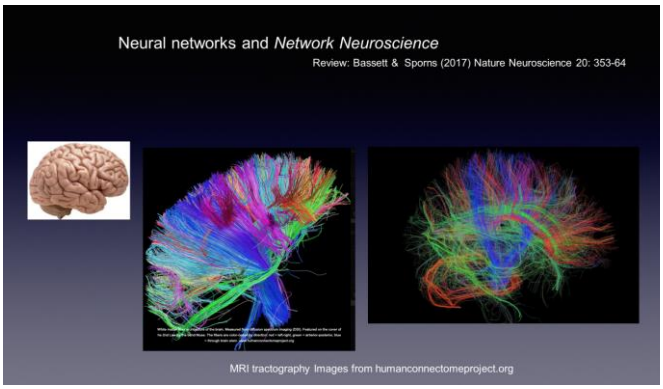
they form networks that produce waveforms. He explained how these waveforms can be exploited in anaesthesia and pain medicine by stimulating the nervous system.

Mike started with a peripheral nerve such as the Sciatic Nerve, which comprises thousands of individual nerve fibres. These fibres are essentially electrical conduits with varying degrees of insulation and communicate, both chemically and electrically, with other nerve cells in the central nervous system. Whilst in humans, nerve cells are less than 20-micron diameter; Hodgkin & Huxley in 1952 published a series of studies on the squid, which has fibres of mm dimensions, that underpinned modern neurophysiology.



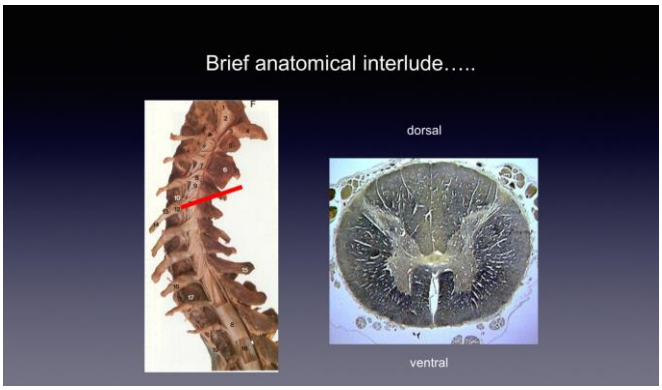
The human nervous system comprise approximately 10 billion nerve cells. The brain has at least 1000 trillion interneuranal connections whose nerve cells are arranged in complex arrays, frequently with columnar architecture. Each of these columns of nerve cells communicate distantly to form neural networks. Advances in MRI scanning have demonstrated the communication of fibres across the brain.

As a pain physician, Mike said that a Holy Grail of pain medicine might well be the ability to measure subjectively the experience of pain and eventually to modify the mechanisms that underlie that experience.

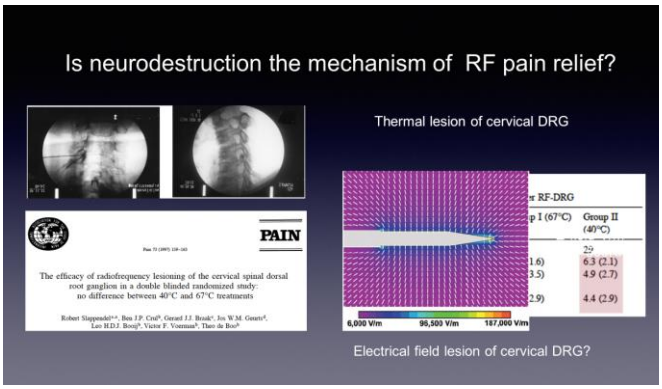


Early work used a radio frequency generator to electrically stimulate part of the nervous system. From a clinical perspective, this can consist of stimulating the peripheral nerves, the spinal cord or the brain by varying the frequency and intensity of the electrical charge. Even today, high voltage stimulation, Electroconvulsive Therapy (ECT), still takes place although it is not recognised as a contemporary treatment for pain. However, repetitive pulses of low electrical frequency can produce temporary pain relief. To try to understand why, Mike took us on an anatomical interlude related to the spinal cord. Transect the cord and you get a pair of dorsal horns where the incoming sensory nerves enter and communicate electronically with the pathways connecting to the brain. "Pain fibres" advising of tissue damage are separate from those fibres that signal non-damage such as the body being touched. Stimulating non-pain fibres can inhibit the effect of incoming pain signals, hence we rub things better….

Consequently, by stimulating the dorsal aspect of the spinal cord itself with implanted electrodes, the management of certain types of pain can be achieved.



Similarly, using a radio frequency, via an insulated needle, an intense electrical field in the vicinity of the exposed needle tip, can produce a predictable and reproducible thermal lesion. Heating nerve tissue above 45°C produces tissue destruction and pain relief in some patients with chronic spinal pain. However, widespread destruction of pain pathways frequently fail to treat long-term pain. A study in the Netherlands has demonstrated that a non-thermal 'lesion' adjacent to the spinal sensory nerve in the neck was as effective as a thermal lesion in producing pain relief. It showed that the electrical field produced by pulses of high voltage created pain relief that lasted 4-6 months. The reason for this is not clear; it may be just the effect of an electric current on the nerve cells!



A detailed understanding of the electrical functioning of a single nerve cell, however, does not explain how we process pain, less still how we sense and process the signal. Understanding the neural network function may enable a better treatment of pain. However, if pain is a product of a diffused connection of neural networks, Mike remained uncertain that we could wholly switch off pain without switching off consciousness! Dr Andrew Graham gave the vote of thanks to Dr Hudspith.

Engineering Tomorrow's Medical Therapies – Ubiquitous problem solving from Organ Preservation to Oncological Drug Delivery and Spinal Surgery. (Virtual Lecture online ~ 9th Nov 2020)

Prof Constantin Coussios is one of the brightest engineering stars of our age. His field of operation includes; the control, maintenance and repair of chemical engineering processes and structure in human systems – Biomedical Engineering. Some of us were lucky enough to meet him last year at the Army and Navy Club on 14th October, and delight in an exciting taster of the diversity of his work at the Institute of Biomedical Engineering at Oxford.

Biomedical Engineering can only be described as "extreme". All engineering disciplines are reduced in size, extended in complexity and interrelated in ways that are not yet fully understood.

His lecture, assisted with an excellent array of slides, started with the development of the world's first normothermic organ perfusion device.

Conventional transplantation surgery had involved the storage and transportation of livers in cold boxes from donor to recipient. This gave considerable risks of

damage from cold, lack of oxygen or accumulation of metabolites. What was required was a device designed to fool the organs into believing that they were still inside the body during the whole period of their preservation.

The Normothermic Perfusion Machine (NPM) maintaining a constant temperature of 37°C had to be fully automated and transportable for periods of up to 24 hours.

It overcomes five challenges:

1. To enable the organ to choose and regulate its own blood flow and supply pressure, ensuring that blood is not forced through the organ, preserving its microvasculature.
2. Anticipate, provide and maintain a "surgeon proof" fully oxygenated blood flow and nutritional needs, supply of glucose, amino acids, bile salts, requiring seven automated closed loop control systems, to deliver a better performance than could be achieved by human control.
3. Minimise the blood volume and red cell damage by using fluid mechanics to minimise shear stress in the perfusion circuit.
4. Provide physical support, liquid containment and prevent air entrainment.
5. Designed to be transportable in containers by air: (1.4m height, withstand 12G in any direction as well as decompression) and transportable in road vehicles and hospital trollies.

The NPM without its Travelling Cover

Prof Coussios quoted Steve Jobs:

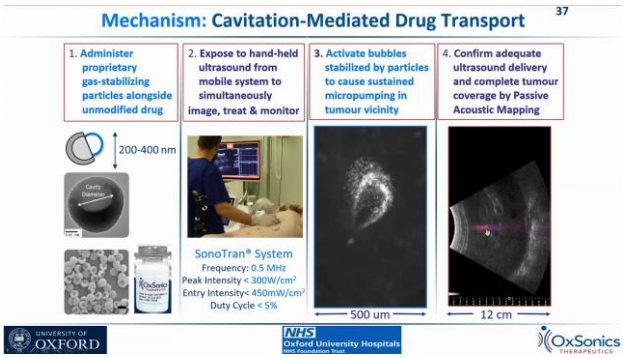
"Design is not just what it looks and feels like, it is how it works".

Prof Coussios co-founded the Oxford University spin-off OrganOx Ltd in 2008 to develop the device. The machine entered clinical practice in 2018. A randomised study using the OrganOx Machine across European sites was published in Nature in 2018 showing halving of the liver discard rate with a 50% increase in the preservation time. Graft injury was halved. The VITTAL study showed that 71% of livers rejected by UK centres could be transplanted using OrganOx. Over 850 NPM livers have been successfully preserved and transplanted in 11 countries and four continents. NHS approval was achieved in January 2019.

Overall, the OrganOx machine improved the viability, gave longer preservation times for transport and surgery as well as increases the supply of livers for transplant, and provides a better outcome for patients.

Prof Coussios then described his work on Cancer treatment, with excellent slides from the"Oxford Centre for Drug Delivery Devices". He explained that the physiology of tumours presents a formidable barrier to the delivery of the nano-particles of the current and emergent anticancer therapeutics. Apparently, only about 1.4 to 0.5% of administered dose reaches the target tumours.

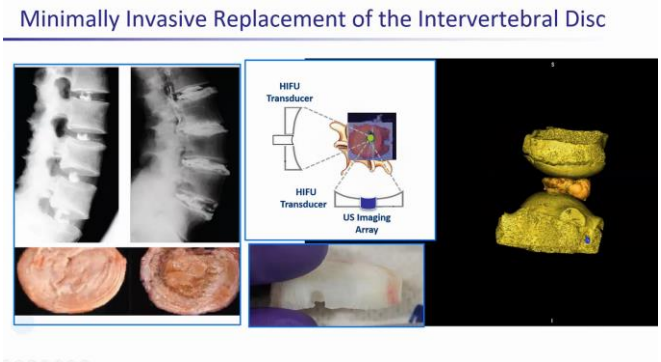
His engineering improvement employed the use of focused ultrasound heating to trigger the release of the thermo-sensitive encapsulated therapeutics. He described how the delivery of these drugs could be improved, again using ultra-sound, to provide forced convection transfer instead of depending on diffusion alone. The mechanism of his "cavitation mediated drug transport", involved administering a drug stabilised with gas micro-bubbles.



Then, once the drug reaches the targeted tumour, using a hand held ultrasound device, the bubbles are activated which releases the drug in concentrated form to ensure complete coverage of the tumour.

In 2014, Prof Coussios co-founded OxSonics Ltd, another Oxford University spin-off to commercialize cavitation for enhanced oncological drug delivery.

Prof Coussios's final example turned to structural engineering and back-pain. This time the aim was to restore the function of degenerated discs with only minimal invasion.



In this entirely different area, he described his technology as basically similar to mending the puncture in a vehicle tyre - induce cavities with ultrasound that were then filled with Hydrogel. In 2016, he co-founded OrthoSon Ltd as another Oxford University company for further development.

In his 20 years of Biomedical Engineering, he has brought innovation into three entirely different areas of medicine: liver transplantation, oncology and spinal surgery. Prof Coussios explained, "Engineering is a way of thinking". His challenge was to translate biomedical research into technology. He quoted Peter Drucker

"The best way to predict the future is to create it !"

Prof Coussios was presented with the Silver medal of the Royal Academy of Engineering for his contribution to organ preservation and ultrasound- enhanced drug delivery. He was elected a Fellow of the Royal Academy of Engineering in 2019.

The Question and Answer session was chaired by Norman Train and covered a wide range of subjects from the diversity of the treatments that his innovations could bring to different organs and the finance that he had been able to win for his various projects. The vote of thanks was proposed by Prof Stephan Jefferis

who commented on the general lack of awareness of the subject of Biomedical Engineering. He reminded us of the French connection with the need for improvement in liver medicine as the solution to "crise de foie" and thanked Prof Coussios for the wonderful insight his lecture provided, his ideas and the speed at which his developments had been achieved.

David Shillito

Prof. Coussios' lecture highlighted the incredible developments in medicine when combined with engineering. However, without organ donors, these miracles cannot happen. In May 2019, British Law changed to Presumed Consent for Organ Donation. The freedom of choice has not been taken away. You can opt-out if you want but your next-of-kin can rescind your wishes so it is vital that you discuss your preference with them.
Our campaign for Presumed Consent started when my brother Peter, a Civil Engineer, died from a brain tumour. His final request was to become an organ donor and he gave a second chance to 17 people who benefitted from him.
Thank you to everyone at IESF who have supported us throughout our 30-year campaign. If you have not considered organ donation, please do so because if you are willing to receive, you should be willing to give and remember, discuss it with your loved ones. Organ Donation really is the Gift of Life.

Rosemary & Christine Cox

New Member 2020

We were delighted to welcome Jenny Curtis as an Amie in April.

2021 IESF Programme can be viewed on the IESF website.

RIP

Terrel Wyatt was a Fellow of both the IStructE and the ICE. Previously Deputy Chairman and Chief Executive of the Costain Group and Director and Chief Executive of W. A. Atkins. A member since 1963.
James Rhind was a Member of both the IStructE and the ICE and a Partner at Engineers Design Associates. A member since 2013.
Birgit Ahm was one of our Amis and widow of IESF Past President, Povl Ahm.
Gwilym Roberts CBE FREng was a Fellow and Past President of both the ICE and the IPHE and a Fellow of both the IMechE and IWES. He was a senior Partner at John Taylor & Sons and Chairman of their successor Acer Consultants. A member since 1977.
Ken Guiver MBE was a Fellow of the Royal Society of Chemistry and a Fellow and President of the Institution of Water & environmental Management. A member since 1989.
Peter Varley was Projects Director at KBR. An IESF Past President and member since 2008.
Poor health has made **Pat Cruddas** resign as an Amie.
We remember three stalwarts who have passed away this year; **Gwen Pocock, Elizabeth Simpson and Anne Duthie.**

A joyful note to end on; **Dr Peter Bradley**, engaged on the Paris Voyage in 2019, married Diane Deacon on 5th September

Our thanks are due to those who have contributed to this newsletter. The editor welcomes contributions on matters that relate to the objectives of the Société. Email:paulgerrard24@gmail.com