LECTURE SUMMARIES *by Dave Williams*

13/03/19 ***Women in Zoology*** Ann Sylph, Zoological Society London

The speaker aims to improve awareness of women's contributions in the past and hopes that this may play a role in improving gender equality. Many women do now work in zoology and wildlife conservation but more would be welcome, There is still a need for more women to study STEM subjects and to have careers in science & engineering.

ZSL is committed to advancing gender equality, diversity, inclusion and equal opportunities for all. It is an international wildlife charity whose vision is of a world where wildlife thrives, and whose purpose is to inform, inspire and empower people to stop wild animals going extinct.

It is the charity behind ZSL London and Whipsnade zoos, and has conservation staff carrying out practical work in the field in over 50 countries worldwide. Joe Pecorelli who has previously given a talk at RSS is one of the conservation staff.

It runs the Institute of Zoology carrying out research in conservation science, the ZSL library and archives, and produces scientific publications and events.

Two of the earliest women that the speaker has found making a contribution to zoological knowledge were the daughters of Martin Lister, Vice President of the Royal Society, who had more than 60 scientific papers published. He relied on Susanna and Anna, aged 11 and 9 in 1681. Their earliest work published in 1685 to 1692 shows drawings with decorative borders like this example drawn by them, from a 1770 reprint.

In 1694 they drew dissections of molluscs seen under a microscope (l*eft*).

A contemporary was Maria Sibylla Merian, a German-born entomologist and artist. Her careful observations of insects helped to disprove the theory of spontaneous generation and proved that insects had a life cycle.

She produced works depicting European caterpillars and their life cycles and food plants. In 1699 at the age of 52 she sailed with her youngest daughter, Dorothea, to Surinam in South America, to study the indigenous insects.

The results of this journey was *Dissertation sur la génération et les transformations des insectes de Surinam,* her magnum opus in which she depicted many species for the first time. ZSL's copy was published in 1826 with Latin and French text.

Later in the 18th century it became more socially acceptable for wealthy women to have an interest in natural history. Queen Charlotte (1744-1818) wife of George III was interested in botany, geology, and Zoology and had a menagerie at Kew.

As more of the world was discovered and described more and more women became collectors. The Duchess of Portland (1715-85) *right* built up a huge collection of specimens, mainly shells but also crustaceans as well as other species.

Madame Knip 1808-43 drew many beautiful illustrations of pigeons *left*.

Fairly local to us was Sarah Child, a wealthy collector of birds kept at her home at Osterley Park, Isleworth. She had over a 100 species, and with husband Robert they commissioned artist William Hayes to illustrate and write descriptions in a magnificent book *Rare and Curious Birds*. The whole Hayes family contributed to the work, with William and his wife Matilda both doing illustrations and the colouring by their daughters Emily and Anne.

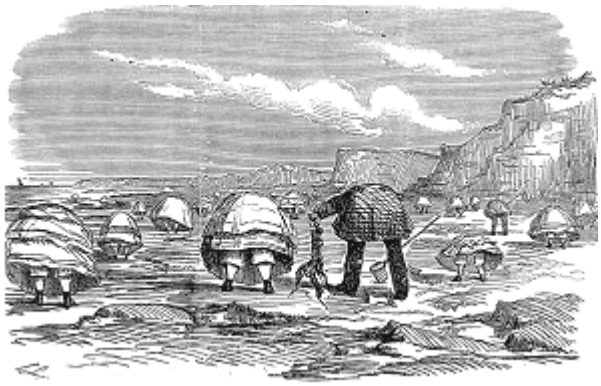
Sarah Stone at the age of 17 was employed by Sir Ashton Lever to record the contents of his Leverian Museum. She was there for 30 years and her illustrations depict many newly discovered species. She illustrated *Journal of a Voyage to New South Wales (1790)* by John White , depicting many Australian species which were new to science.

ZSL has a collection of papers which include letters from Mary Anning *right* to William Buckland. She was born in 1797 and lived in Lyme Regis.She was a fossil collector, dealer, and palaeontologist.

Some of her finds including ichthyosaurs are in the Natural History Museum.

ZSL was established in 1826 by Sir Stamford Raffles, founder of Singapore, and Sir Humphry Davy, designer of the miner's safety lamp and president of the Royal Institution. Raffles sadly died soon afterwards, attending only one meeting of Council.

Almost from the start women were admitted as Fellows from 1827. Sophia Raffles, Sir Stamford Raffles' widow, was the first woman Fellow. This was highly unusual for the time; most learned societies did not admit women until the 20th century. She was the author of his biography which includes detailed lists of his animal collections.



COMMON OBJECTS AT THE SEA-SIDE—GENERALLY FOUND UPON THE ROCKS AT LOW WATER.

In Victorian times there was a craze for seashore collecting – as illustrated by this cartoon in Punch. Women were active participants. Benefiting from this interest in seashores was Mary Roberts, a natural history writer of 15 books. They took the format of letters to a friend, similar in form to Gilbert White's Natural History of Selborne.

Maria Emma Gray *right*. Between 1842 and 1874 she etched 5 volumes of plates for *Molluscus Animals*. she mounted and arranged the Cumming collection of shells in the British Museum and was an unlisted contributor to her husband's writings - John Edward Gray, Keeper of Zoology at the British Museum.

John Gould, a curator of birds at ZSL, created folio volumes many of which were magnificently illustrated by his wife Elizabeth Gould, who drew and lithographed 600 illustrations. She accompanied him on a 2-year expedition to Australia. She also illustrated the bird volume of *The zoology of the voyage of H.M.S. Beagle, under the command of Captain Fitzroy, R.N., during the years 1832 to 1836*, edited and superintended by Charles Darwin, London : Smith, Elder, [1838]-43.

Another woman associated with the Gould's was Jane Catherine Ward, circa 1817-1889, later becoming Mrs Charles G. Tost. She was from a family of taxidermists and also worked as one. In the 1841 census, Jane was listed as a 'bird stuffer'. She worked in the Gould's taxidermy shop while they were travelling in Australia. At that time ZSL had a museum which was located in John Hunter's former house in Leicester Square. Hunter lectured and carried out demonstrations in the house dissecting bodies to gain medical knowledge.

Richard Bowdler Sharpe was ZSL Librarian appointed in 1867. He was a noted ornithologist and became Curator of Birds at the British Museum. He had 10 daughters and at least 9 of these acted as colourists in several beautiful and informative zoological titles. There was a market for beautifully illustrated books at that time and these women were valued by the artists of many of these works as they took such care in using the correct colours which are particularly important in identifying birds. Even today illustrations are often used rather than photographs. The 10th daughter, Emily Mary Bowdler Sharpe was an entomologist and was associated with the British Museum. The speaker believes she was not only the first woman to author a paper, but the first person to author a paper for ZSL

Science became increasingly professionalised in the 19th century making it difficult for women to gain a foothold. But in the 1880s Bedford College began to offer women courses in zoology, with the first women gaining BSc in zoology in 1897 being Agnes Kelly and Helen Pixell. Helen Pixell became a demonstrator in Zoology at Bedford College. She was a Fellow of ZSL and was awarded her Doctor of Science in 1915. She left when given the opportunity to study polychaete worms on the Pacific coast of North America.

From the early 20th century women increasingly gained degrees in zoology and the first world war gave them additional opportunities.

Philippa Esdaile became Head of Dept at Bedford College during the 1st World War, graduated from Manchester and then went to University College Reading. She published papers on the life of the salmon. Her work on the skull of the bandicoot led to Manchester awarding her an MSc for her research in 1911, gaining a DSc in 1917. She left in 1920 and in 1921 became Head of the Biology Department at Queen Elizabeth College in Kensington until she retired in 1951.

At ZSL there were more opportunities for women. Marion Saunders *right* ran poultry exhibitions to encourage the public to keep chickens for eggs.

With Henry Peavot, ZSL's Librarian away at the front, his wife Maud ran the Library until the end of 1917. Sadly Henry died and a Fellow, Mrs Wood-Jones carried on as librarian for much of 1918.

In May 1917, Lucy Evelyn Cheesman was appointed as Assistant Curator of Insects, becoming Curator in 1920. The Insect House was seriously depleted when she started and she engaged local children to catch insects for the House. She went on many expeditions to the South Pacific, the last at the age of 73 following a hip replacement operation.

The 1920s offered more opportunities for women as more had gained degrees in zoology. A demonstrator role at Bedford in 1924 had applications from 20 women; their degrees were from a range of universities including applications from women with degrees from Liverpool, Birmingham, Manchester, Aberdeen & Durham.

In 1923 Joan Procter was appointed by ZSL as Curator of Reptiles and Amphibians; she wrote many articles and papers and was a talented artist. She designed the Reptile House at ZSL London Zoo as well as helping with design of the Aquarium. Here is a photograph taken by the Daily Express at the time.

Marie Lebour worked at the Marine Biological Association mainly studying the planktonic larvae of crabs; much of her work was published in ZSL Proceedings. She studied zoology at Armstrong College, now the University of Newcastle, did research there and moved to the University of Leeds in 1907, being awarded a DSc in 1917. She was also a talented artist.

Alice or Elsie Sexton was a marine artist also based at the Marine Biological Association in Plymouth from 1900, she first published in ZSL Proceedings in 1908. She worked on 35 species of Amphipod crustaceans and described some species for the first time. She studied their life cycles and genetics, publishing over 30 research papers between 1908 & 1951.

Nellie Eales was the first woman in the UK to be awarded a PhD, in her case from Reading in 1921. She first published work on cheese mites then moved to marine biology.

"The Littoral Fauna of the British Isles is I feel one of her most important works and was a key book when I was studying for my degree. She was President of the Malacological Society of London and when she retired she catalogued early zoology and medical books in Reading University Library – as a Librarian myself I do need to mention that!"

"Moving into the 1930s and the rest of the 20th century I have been very selective and tried to highlight women with direct links to ZSL. At our zoos the only women keepers worked in the Children's Zoo."

In zoological research Sidnie Manton worked on the evolution of arthropods and analysed their movement. She was the 7th woman to become a Fellow of the Royal Society (1948). Her sister

Irene also elected a Fellow of the Royal Society. They were a high achieving family! Sidnie was awarded ZSL's Frink Medal for British Zoologists in 1977, designed by Elisabeth Frink.

Miriam Rothschild was the first woman to be an Honorary Fellow of ZSL; she was a world authority on bird fleas and was recognised for her support for wildlife conservation. She was instrumental in setting up the IUCN - the International Union for Conservation of Nature. She was elected as a Fellow of the Royal Society in 1985. She had 6 children and she said she did her zoology in the evenings after they had gone to bed. She said she wrote the book *Fleas, Flukes and Cuckoos* when she was stuck in Calais for a week in 1947 waiting to cross the Channel.

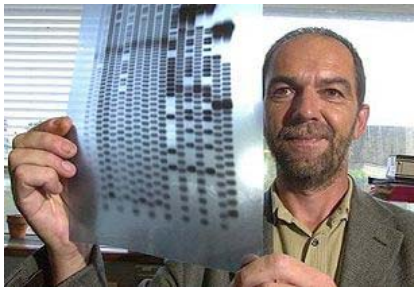
Moving into the 1990s and early 21st century at ZSL we had Georgina Mace our first woman Director of Science, Alexandra Dixon our first Director of Conservation and Heather Koldewey our first woman Curator since Joan Procter in the 1920s.

The progress of women in zoology has not been constant but a series of peaks and troughs. Many woman did find their niche studying often smaller less charismatic animals or carrying delicate work and were often unaccredited. The 1950s and 1960s were particularly difficult especially for women employed in research by the government or with employers with Civil Service working conditions. Women had to leave when they married. *"I do wonder how many simply lied to have a career or married wealthy men who could fund their research"*.

And now? Many women are working at ZSL in a wide range of roles. They are carrying out research in conservation science and many work in the field on practical conservation projects. 63% of Conservation staff and 51% of Keeping staff are women

"To find out more about women and zoology, we have a number of blogs on our website.
I compiled a free virtual issue of our Journal of Zoology about women and marine zoology:
`http://tinyurl.com/y5d5vcon`
whilst one of my former colleagues compiled a Women and Zoology virtual issue:
`http://tinyurl.com/y43b4g38`
And of course do use our Library's resources and visit our current display of artworks by women."

10/04/19 ***Forensic Science: DNA evidence*** Dr Georgina E. Meakin, UCL

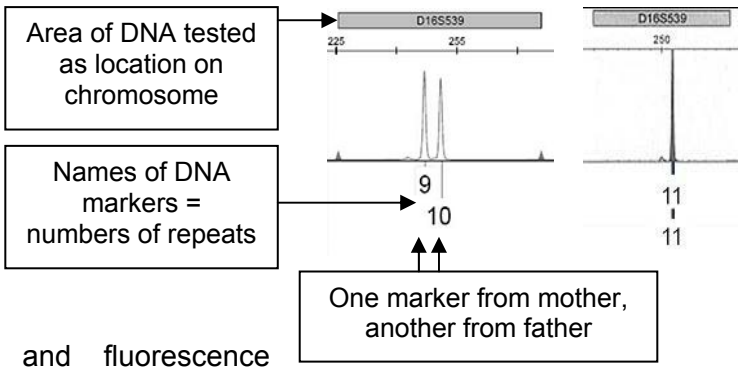


A picture of Sir Alec Jeffreys, who in 1984 discovered the possibility of DNA profiling, which uses variations in the genetic code to distinguish between individuals.

Chromosomes contain coding DNA called genes, plus noncoding "junk" DNA. Some regions of "junk" DNA consist of 4-letter repeats called short tandem repeats (STRs). The number of repeats at a particular location within the DNA can be determined and can vary between people.

DNA extracted from a sample of bodily fluid can be mixed with chemical reagents and amplified, such that DNA copies of areas containing STRs are made that are fluorescently tagged.

These DNA fragments are run through a capillary electrophoresis instrument that separates out the fragments by length and fluorescence.



A particular combination of length and fluorescence corresponds to a particular STR, with amplitude proportional to quantity, as in these two examples:

The second example shows an 11-repeat contribution from each of the parents, which gives just one peak.

Colin Pitchfork was the first person convicted of murder based on DNA profiling evidence, and the first to be caught as a result of mass DNA screening. Pitchfork raped and murdered two girls in Leicestershire, the first in Narborough in 1983, the second in Enderby in 1986. He was arrested in 1987 and sentenced to life imprisonment in 1988 after admitting both murders.

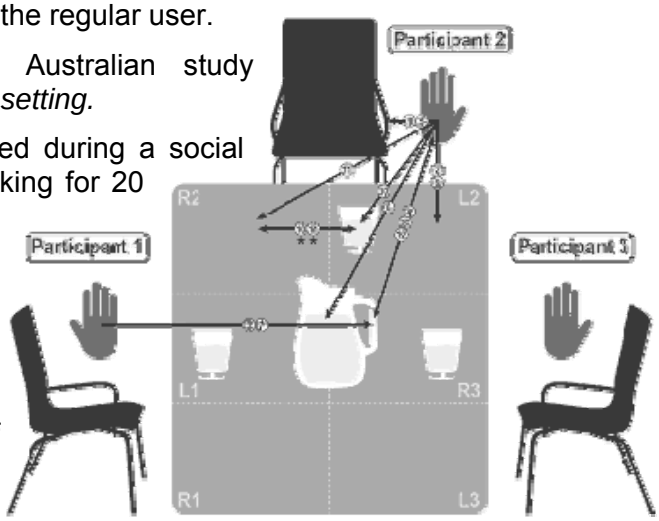
DNA profiling continued to be used, but in 1997, research in a published paper demonstrated that DNA can be deposited via touch (so-called "Touch DNA") and that this DNA could be transferred via innocent intermediary persons and/or objects (so-called "indirect transfer"). However, it took until the mid-2000s for it to be accepted that this indirect transfer is indeed possible in casework scenarios, and not just within laboratory experiments.

In 2012, a millionaire Raveesh Kumra was robbed and killed. Initially, the wrong suspect was accused owing to his DNA being found beneath the deceased's fingernails. Later, it was discovered that his DNA had been brought to the murder scene by a paramedic who had treated another man prior to attending the crime scene.

Our speaker was chief contributor to a 2017 paper *Trace DNA evidence dynamics: An investigation into the deposition and persistence of directly- and indirectly-transferred DNA on regularly-used knives*. This paper showed that even when items such as knife handles have background DNA present from a regular user, indirectly-transferred DNA can be detected and persist, albeit at a lower level than the DNA from the regular user.

She also showed diagrams from a 2015 Australian study *The complexities of DNA transfer during a social setting.*

This showed how easily DNA can be transferred during a social situation when participants sat talking and drinking for 20 minutes, all using the same water jug, but with individual glasses.



In this diagram, the movements of DNA only originating from Participant 1 are shown by arrows, demonstrating the direct transfer of DNA from Participant 1 to the jug handle via touch, and then the indirect transfer of Participant 1's DNA from the jug to a variety of surfaces handled by Participant 2.

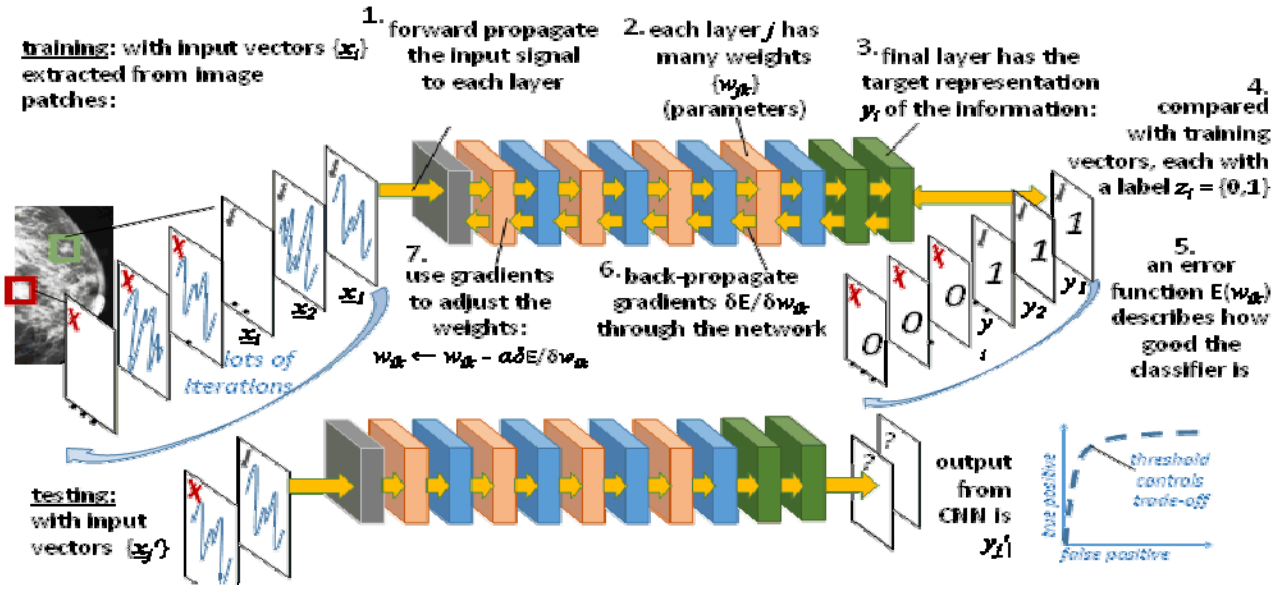
The speaker co-authored a 2013 paper titled *DNA Transfer: review and applications for casework*, which raised awareness within the forensic science community of the importance of considering DNA transfer within the interpretation of DNA evidence in casework and the need for more research in this area to understand it better.

Ethical issues:

- The accused must remain innocent until proved guilty, but it is often not possible to use the found DNA traces to prove guilt, given the above considerations of DNA transfer.
- For the purposes of crime investigation, when considering the use of DNA databases owned by companies that take DNA samples from the general public e.g. for ancestry purposes, individuals need to understand what they are consenting to when providing their DNA.
- Storage of DNA samples from innocent people can be thought to be in violation of GDPR if appropriate consent has not been obtained.
- Physical characteristics, such as eye, hair and skin colour, can be predicted from DNA, but to varying degrees of accuracy. Meaningful descriptions of personal characteristics are dubious.

The talk concerned the use of neural networks and artificial intelligence to extract meaningful information from images, for example face-recognition.

An example of deep learning application architecture:

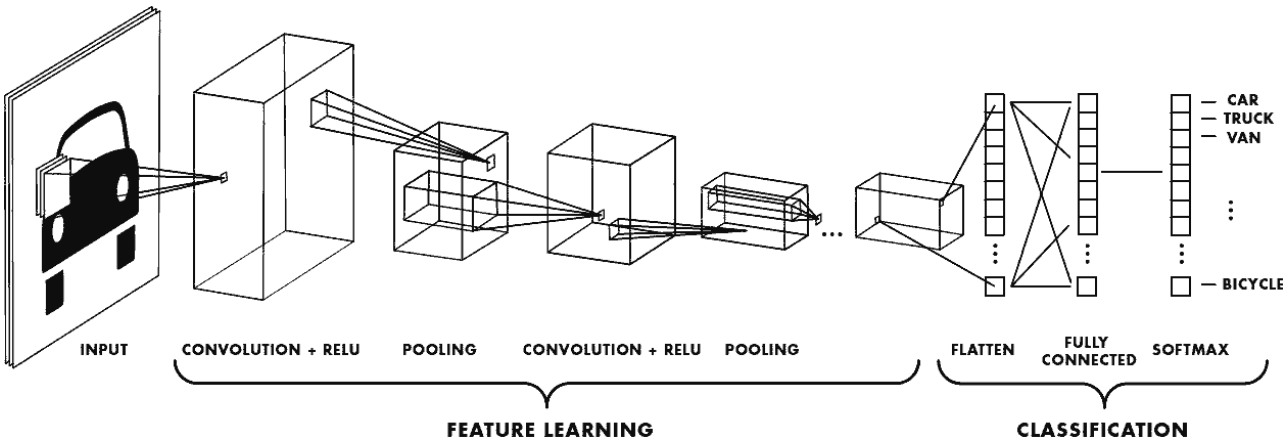


[See: Cireşan, Dan C., et al. "Mitosis detection in breast cancer histology images with deep neural networks" International Conference on Medical Image Computing and Computer-assisted Intervention. Springer, Berlin, Heidelberg, 2013]

On the left is a set of mammogram images containing various cancerous and non-cancerous spots. These are processed by the neural network 1, 2, 3, producing a set of possible identifications. These are labelled as true or false 4, 5 by experts, and used to modify the network stages 6, 7, in such a way as to improve the output.

The process is repeated until the results become all true. Now the network is tested by supplying new images, and the results assessed. When an acceptable trade-off between true and false results is achieved, the training is complete.

The phrase 'Deep Learning' comes from the fact that the network is many layers deep. The layers are of two alternating types: convolutional (*pink*) and max pooling (*blue*).



[*This figure was included in a slide and is to be found at* `tinyurl.com/y9mmosuq` *which explains the terms with animated diagrams DW*]

Learning requires as big a data set as possible. It was found best to work on small samples and use the results to refine the analysis of subsequent samples. The amount of input data can be augmented by for example changing the lighting, adding geometric variations and random noise.

Engineering software is constantly evolving; modern toolkits such as GoogleTensorflow, Caffe, Matlab NN toolbox etc accelerate development, and facilitate rapid testing, adoption of standards

and re-usable artefacts. Many papers are made public on the internet while waiting for acceptance by the institutions, so helping other researchers immediately.

Computer hardware is also evolving. A 1999 Nvidia GeForce graphics processing unit for video games turned out to be just the thing for training neural networks, resulting in the 2015 Google Tensorflow Processing Unit (TPU), and now the 'edge' TPU with > 8-fold performance increase.

CALENDAR OF SCIENTIFIC EVENTS September - November 2019

Day	Date	Time	Host	Title
Wed	11 Sep	**20:00**	**RSS**	**Plastics**
Mon	16 Sep	18:00	IET	Digital to Physical How virtual designs inspire the products and factories of the future
Thu	19 Sep	18:00	LS	Sampling the Deep
Sat/Sun	21-22 Sep	All day	RS	Open House
Wed	2 Oct	13:00	GC	Faster than Light?
Tue	9 Oct	13:00	GC	The Maths of Future Computing
Tue	15 Oct	18:30	IOP	Data Science: “The Sexiest Job of the 21st Century”?
Wed	16 Oct	**20:00**	**RSS**	**The Surface of Mars: The Geological History of the Red Planet**
Tue	22 Oct	18:00	GC	Biometrics: How Unique Are You?
Wed	23 Oct	13:00	GC	Frozen in Time
Fri	25 Oct	14:00	IET	Can AI Help Over-Worked Sonographers?
Wed	30 Oct	18:00	GC	Infection, Immunity and Cancer
		18:30	IOP	Shining Light on the Brain: Optics in Medicine
		20:00	**RSS**	**From Gout to Mad Cow Disease. My Bioscience Life in Medicine**
Mon	4 Nov	13:00	GC	Weighing the Universe
Tue	12 Nov	13:00	GC	Maths and Voting
Wed	13 Nov	18:30	IOP	Elementary! My Dear Mendeleev
		20:00	**RSS**	**Human Longevity**
Wed	20 Nov	13:00	GC	The End of Matter
Wed	27 Nov	18:30	IOP	DUNE - an international neutrino observatory

All events are free but booking may be required. Some can also be viewed online live and later.

Host Venues:

IET: Institution of Engineering and Technology, 2 Savoy Place, London WC2R 0BL
https://events.theiet.org

IOP: Institute of Physics, 37 Caledonian Road, King's Cross, London N1 9BU
https://www.events.iop.org

LS: Linnean Society, Burlington House, Piccadilly, London W1J 0BF
https://www.linnean.org/meetings-and-events/events

GC: Museum of London, 150 London Wall, EC2Y 5HN
http://www.gresham.ac.uk/lectures-and-events

RS: Royal Society, 6-9 Carlton House Terrace, London SW1Y 5AG, (020) 7451 2500
https://royalsociety.org

RSS Richmond Scientific Society, Vestry House, 21 Paradise Road, Richmond TW9 1SA
http://www.rss.btck.co.uk/lectureprogramme