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# ENERGY SPECIAL

# ZIKA

Women in science  
November 26th 2016 -  
23rd February 2017

The  
view  
from  
Beacon  
Hill

Science at the cutting edge internationally:  
what scientists and politicians need to know

THE UK FORENSIC SCIENCE REGULATORS  
REPORT RELEASED JANUARY 2017

Donkey Riding Column - Justice in the dark  
From British Courts

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Save it for your records!

## WE ENABLE, INFORM, PROVOKE AND ENGAGE

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*Science, People & Politics* is a scientifically literate title aimed at scientists and politicians.

## EDITORIAL: PAIN AND CONSCIOUSNESS

Let us rename pain - trees.

Let us rename consciousness - the emergent genetic property of treeness.

A.

If the pain no longer exists, does that now non-existent pain exist in the present?

If the tree has been chopped down, does the tree exist in the present?

Not as memory, but as reality?

B.

If no other than the consciousness experiencing pain in the moment knows of the pain, does the pain exist for the wider community?

If no other than the emerging genetic property of being a tree “knows” of the tree, does the tree exist for the forest? I.e; no wind, no pollen, no pheromones. Nothing.

C.

If the pain exists, but the conscious entity does not know that the sensation experienced is pain, does the pain exist?

If the tree exists, but the emergent property of its genes does not know that the tree is a tree, does the tree exist?

D.

If the pain exists, but the biology carrying signals to the interpreting consciousness are severed, does the pain exist?

If the tree exists, but the cell signalling pathways of its DNA are disrupted, does the tree exist?

E.

If the conscious entity likes pain, then is pain, in fact, pain?

If the emergent essence of the tree’s genome has what could be interpreted as a favourable response to the tree, is the tree a tree? **HG**

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THE CONTENT OF THIS PAGE OF ISS ONE (JANUARY-MARCH) 2017 OF *SCIENCE, PEOPLE & POLITICS*, AND SOME OTHER PAGES IN THE ISSUE, WERE PUBLISHED AFTER THE NOMINAL DATE OF PUBLICATION, 24<sup>TH</sup> FEBRUARY 2017, THE CONTENT ON ALL THIS ISSUES PAGES COULD, HOWEVER, HAVE BEEN PUBLISHED BEFORE THAT DATE. FOR REASONS BEYOND THE PUBLISHER’S CONTROL THE ISSUE IS BEING RELEASED PIECEMEAL. 9<sup>TH</sup> APRIL 2017 IS THE LAST DATE ANY CONTENT WILL BE ADDED. BLANK PAGES AT THAT TIME WILL CARRY ADVERTS FOR ILLUSTRATIONS BY HELEN GAVAGHAN. THIS IS THE FIRST ISSUE OF THE TITLE WHICH IS TO BE PRINTED AS WELL AS PUBLISHED ONLINE: FIRST AS PDF, AFTER THREE MONTHS, THE ISSUE WILL BE FREE-TO-READ-ONLINE AS HTML. THREE VERSIONS (PRINT, PDF AND HTML ONLINE) ARE PAGE-FOR-PAGE THE SAME.

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## WOMEN IN ASTRONOMY

Throughout science there are gender disparities. That is clear from the number of women who are Fellows (or Foreign Fellows) of the Royal Society. But clearly women are competent. See p20 of this issue for a sense of what women in science have done during the last quarter (26th November 2016 to 24th February 2017), from stepping down as a patron after 64 years from the Royal Institution, to winning grants, writing blogs as director of the US National Science Foundation, and taking over important industry-based administrative and leadership roles.

What can account for women astronomers being significantly less likely to be allocated observing time at The European Southern Observatory (ESO), which is an issue brought to the attention of this magazine by one of its editorial advisors, Dr Ferdinando Patat, from ESO?

For the answer science, I think, must call on the skill and research tools of sociology. Sociology systematically interrogates societies, its subsectors, and its structures, nationally and trans-nationally. There is a specific field known as the sociology of science. It is time to ask sociologists to bring their expertise to bear to provide insight into structures and relationships internal and external to astronomy. Dr Patat's systematics reveal the issue exists. Systematics from sociology, calling on the plausibility of its knowledge bases, is needed to determine how observing time at ESO by men and women principal investigators can be more equitable while maintaining quality. If there is a dearth of women at influential/leadership levels in astronomy, the field might well be doing itself disservice. **HG**

### QUIZ ANSWERS ISSUE ONE (JAN - MARCH) 2017. SEE P31 FOR THE QUESTIONS

1. Tuesday 8th November 2016. Source: *New York Times*, 9th November, 2016.
2. Friday 20th January 2017. Source: *Toronto Sun*, 20th January 2017.
3. Antonio Guterres.
4. Sir Venki Ramakrishnan.
5. Juan Manuel Santos.
6. CERN ESA, EMBL.
7. October 10th, 1967. Source: US State Department.
8. Indian Space Research Organisation.
9. Dr Margaret Chan.
10. Jean-Claude Juncker. Source: [https://europa.eu/european-union/about-eu/presidents\\_en](https://europa.eu/european-union/about-eu/presidents_en)

# US Patent and Trial Appeal Board transcends biology

By Helen Gavaghan

Earlier this month the United States Patent and Trademark Office settled an Intellectual Property dispute which may prove to be the most significant in biology for the twenty-first century. At issue was whether, given the state of the art at the time, what one party claimed as invention for the gene-editing system known as CRISPR-cas9\* could have been thought to be obvious in another setting. Settings under discussion in this case are prokaryotic and eukaryotic biology - namely all of life. The IP dispute is known as an alleged interference.

The conclusion reached by the administrative patent judges was that the parties to the dispute had patentably distinct subject matter.

Rarely are litigants more prestigious, and rarely do they have deeper pockets. In this case the disputants were the Broad Institute Inc., Massachusetts Institute of Technology and President and Fellows of Harvard College v. Regents of the University of California, the University of Vienna, and Emmanuelle Charpentier.

Throughout the decision handed down the judges write of the University of California and their co-litigants as UC (these are the senior party in the litigation), and of their opponents as “The Broad” (the junior partner in the litigation). UC are the Movants in the dispute, and had argued that their claim to the invention of CRISPR-cas9, not restricted to any environment, would obviously also work in eukaryotes. The Broad, with different claims for CRISPR-cas9 in eukaryotes, disagreed, and argued it was not obvious that CRISPR-cas9 would work for gene editing in eukaryotes. The Patent Trial and Appeal Board judges agreed with Broad.

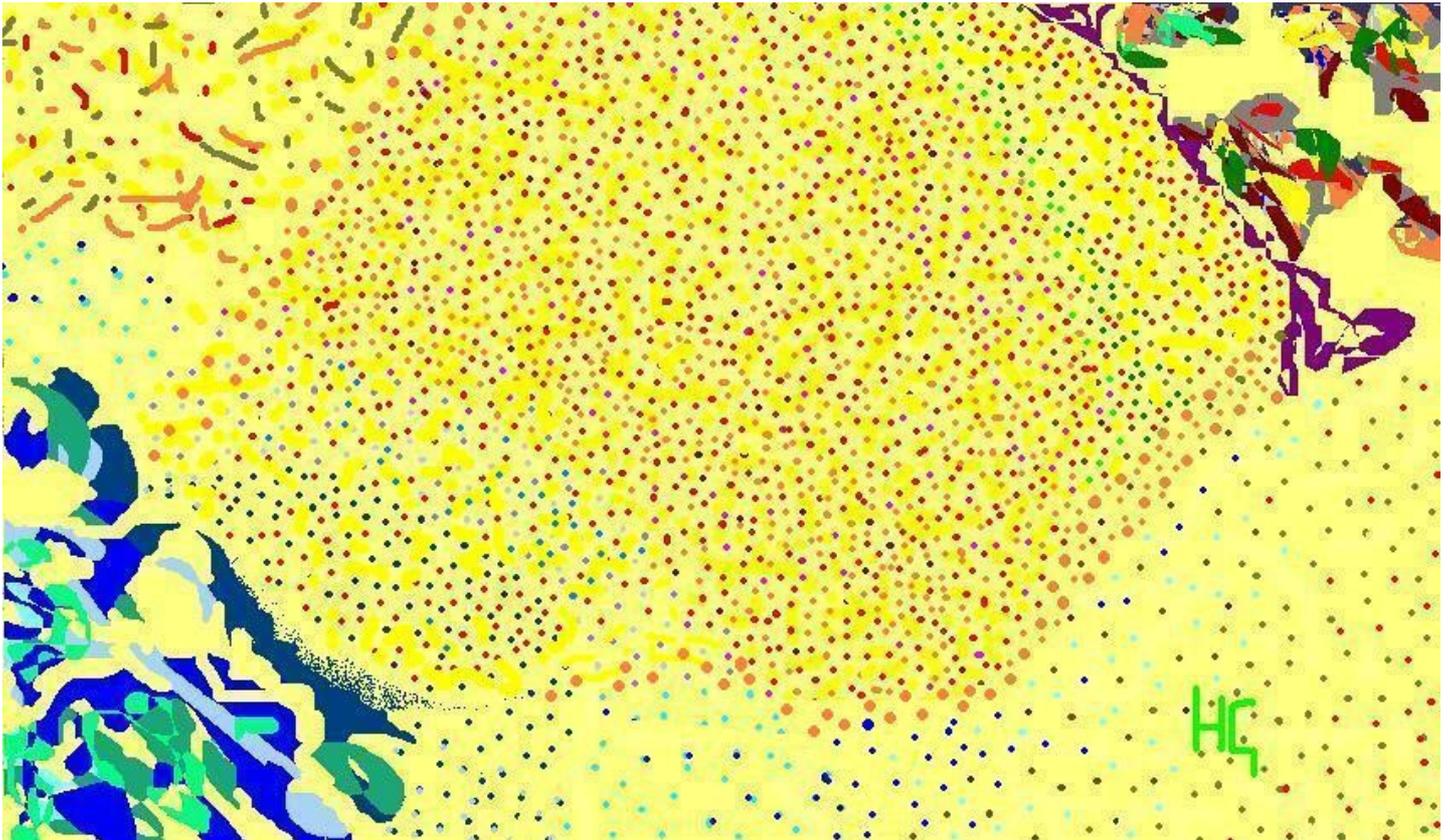
As “The Movants” the burden of proof remained with UC, and the case was decided on the preponderance of the evidence. The administrative patent judges reached their conclusion *per curiam*. In other words, UC lost, and “The Broad” has a distinct patent application and claims for the CRISPR-cas9 system in eukaryotes. And *vice versa*.

Each side fielded experts in molecular biology and genetics to support their case. The legal argument came down to whether, in light of the art at the time, there was a reasonable likelihood that a person with an ordinary knowledge of the art could have expected the CRISPR-cas9 system as invented by UC *in vitro* and in prokaryotes to work in eukaryotes.

On nearly every biological argument UC failed to convince the judges that CRISPR-cas9 in eukaryotes was obvious. Where doubt was raised, UC’s point was argued out of significance by the judges drawing on biology, case law and expert opinions presented to them.

The judges point out they gave greater weight to expert opinions of the time about obviousness

# BROADCASTING



For illustrations of science or technology concepts  
Contact Helen Gavaghan at [helen.gavaghan@btinternet.com](mailto:helen.gavaghan@btinternet.com)

I plan to be at ESOF [EUROPEAN SCIENCE OPEN FORUM] 2018 in Toulouse. **HG**

than to words developed for litigation. By “The Time” the judges mean when UC inventors published their research in *Science* [Jinek *et al*] in August 2012(1).

The judges write,

“... we are still persuaded by Dr Carroll’s statement made contemporaneously to Jinek 2012 ‘There is no guarantee that cas9 will work effectively on a chromatin target or that the required DNA-RNA hybrid can be stabilized in that context... Only attempts to apply the system in eukaryotes will address these concerns.’”

Though cited by the judges in support of their finding for the Broad, Dr Carroll was UC’s expert witness. The judges write also that a scientist’s enthusiasm for their own work is not a convincing argument that CRISPR-cas9 had an obvious chance of success in eukaryotes. Nor did they accept that because the application of CRISPR-cas9 had worked in eukaryotes that that meant it was obvious it would work.

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\*CRISPR-cas is an acronym for Clustered Regularly Interspersed Short Palindromic Repeats associated with Cas. Cas is a protein.

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(1). Jinek *et al* (2012). “A Programmable Dual-RNA-Guided DNA Endonuclease in Adaptive Bacterial Immunity”, *Science* **337** pp 816-821 DOI: 10.1126/science.1225829

Helen Gavaghan edited the patents page in the technology section of *New Scientist* for three years as one of her duties during the 7 years she was on staff at the magazine.

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**ADVERT**

**The next issue of**

**Science, People**

**&**

**Politics**

**Is**

**Friday 26th May 2017**

## Overseeing Quality: Forensic Science Regulator Report Released

In January the Forensic Science Regulator for England and Wales released her annual report. Highlights are to be found in the feature – “Forensic Science Regulator calls for adherence to standards and vigilance” – beginning on page 24 of this issue.

The final part of the feature continues below:

### FORENSIC SCIENCE REGULATOR FEATURE CONTINUED FROM PAGES 24-25

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anthropology; work with the International Organisation for Standards (ISO) to develop quality forensic science provision without “additional regulatory burden”

Resources are, of course, mentioned in various places within the report, but it is the need to take standards seriously which most preoccupies the regulator. The report reflects someone politely keeping up the pressure on police forces to comply, and someone aware that forensic science of quality is essential to both victim and defendant within the Criminal Justice System.

#### Research priorities include:

Underpin the scientific basis of methods used for facial comparisons;

Studies on the transfer and persistence of trace evidence, and the significant factors affecting the transfer;

The frequency of occurrence of patterns such as fingerprint characteristics or the characteristics of a gait.

Acknowledging the opening in 2016 of the Leverhulme Research Centre for Forensic Science, Dr Tully writes that also,

“... the Regulator is keen to support high quality research proposals, by reiterating to research councils the impact that such research can have”.

The FSR’s annual budget in 2015/2016 was £608,000.00, and in 2016/2017 that had dropped to £547,170.00

In both reported financial years Dr Tully’s unit comprised one person, herself, working 0.6 full-time equivalent hours, and three peoples with specialist scientific roles, each working the equivalent of full time hours.

Dr Tully has made a submission to the Home Office for a modest staffing increase.

HG

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# THE GLOBAL ENERGY CHALLENGE

Here I propose how science and politics could engage with the world of money to identify energy projects for sustainable finance. Without prioritising energy it is hard to see how the UN development goals will be met by 2030. Without sustainable finance endorsed as ethical through diplomacy it is hard to see how war can be avoided.

By Helen Gavaghan

## A CALL TO SCIENCE AND POLITICS

### THE UNITED NATION GOALS ARE

No poverty

Zero Hunger

Good health and well being

Quality education

Gender equality

Clean water and sanitation

### AFFORDABLE AND CLEAN ENERGY — SDG 2030 — GOAL 7

Specifically: energy efficiency, renewable energy and access to modern energy

Decent work and economic growth

Industry, innovation and infrastructure

Reduced inequalities

Sustainable cities and communities

Responsible consumption and production

Climate action

Life below water

Life on land

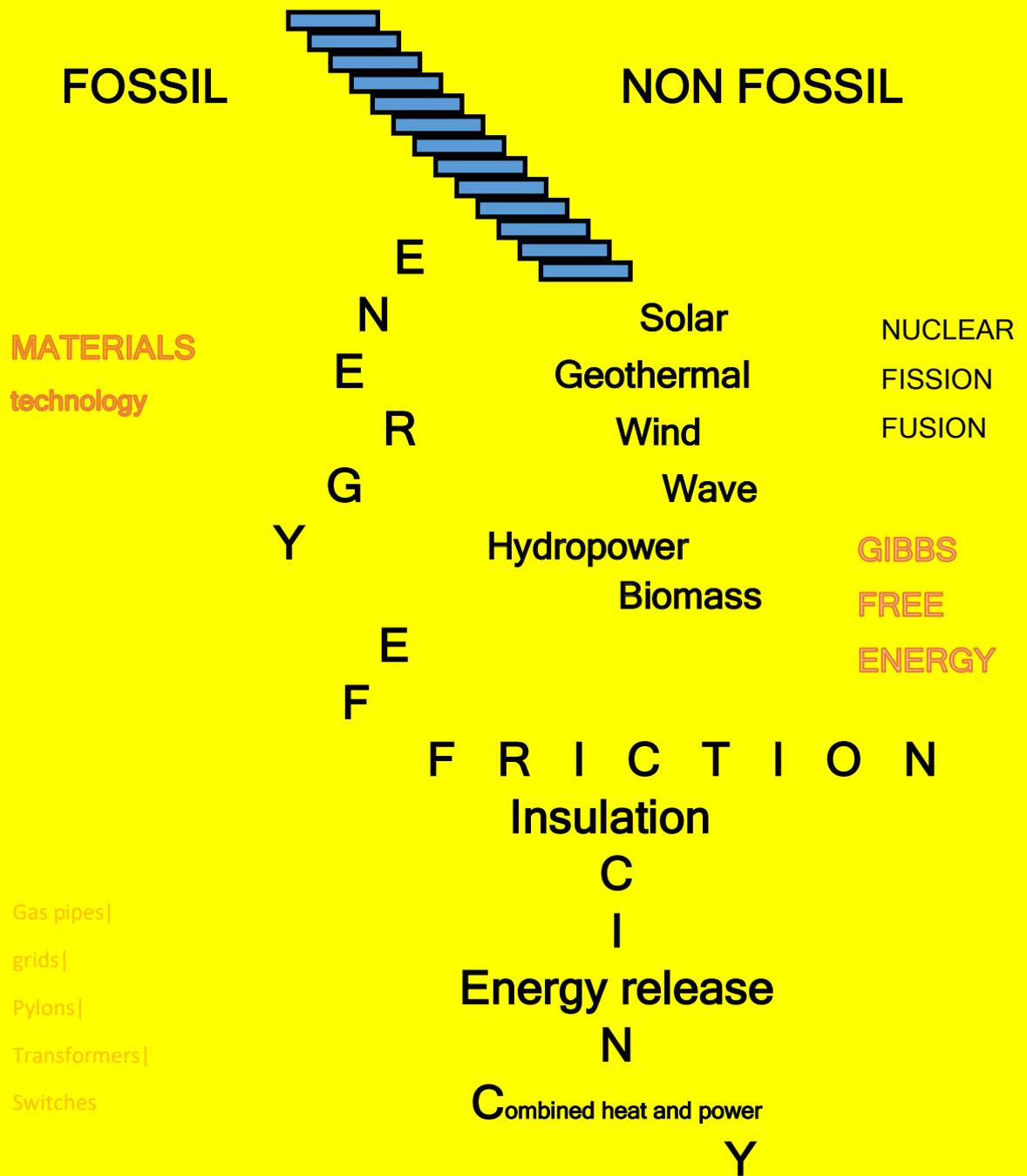
Peace, justice and strong institutions

Partnerships for the goals

**IMAGINE YOU RUN A COUNTRY** and must develop power generation, transmission, distribution and customer connections to fuel-supply lines or an electricity grid. Review with your mind's eye your country's scientific knowledge, technical competence, legal infrastructure and natural resources. Your exchequer is empty. So you need to borrow from the World Bank or European Bank for Reconstruction and Development, or some such, but you are already in debt. The following equation won't magically conjure a loan, but if analysed it might help.

**Consider:** Earnings (in this context earnings is operating profit, actual or projected) = net profit + interest + tax + depreciation of physical asset + amortization of non-tangible asset, such as a favourite patent. [It might also be a help to quantify separately how much you are owed for energy already sold if that money is unlikely to be paid.] Can science and politics jointly optimise

CONTINUED ON PAGE 12. ENERGY INFOGRAPHIC FACING BY HELEN GAVAGHAN©



Material disposal=energy cost  
 Material shaping and forming=energy cost  
 Material maintenance=energy cost

radiation

HG © [Transport Heating Cooking Irrigation Sanitation Storage Harvesting Threshing Spinning]

**“Unlike conventional generation, most renewable power plants can be developed only in certain locations, where the resource is strongest. This requires the deliberate design of a transmission system to reach those areas, rather than passively allowing generation to be developed around existing or planned transmission lines.”**

**P 57. Regulatory Indicators for Sustainable Energy. February, 2017. Published by the World Bank.**

CONTINUED FROM PAGE 10...

the formula such that actual or predicted earnings look good enough to attract a loan for energy infrastructure. Assume a stable economy and non war torn country, even if you are at war. That's what the archives suggest Britain did as World War II drew to a close. For now don't worry about whether unforeseen ethical problems could sink your loan request. First assess your financial case. Do not assume ethics might not be an issue.

Let's take the formula term by term. It is an acronym known as “earnings before interest, tax, depreciation and amortization (EBITDA), and is probably unfamiliar to most scientists and politicians. Merriam Webster places the word in the lower 20 percent looked up. An analogy, therefore, might help. I propose scientists conceptualise earnings on the left hand side of the equation as they would pressure.

Pressure indicates temperature and volume at the time and place of measurement. Take air pressure in a room. Might a hidden open door expand the surface over which pressure is exerted, thus reducing local impact. Could measuring equipment be broken, not moving smoothly, or not sensitive enough to give a meaningful measurement for the degree of detail needed.

Scientists considering pressure have such provisos engrained in their thinking. They envision size, dimensions and strength of a container, ability to withstand uniformly the pressure, likely volume throughputs and flow variations. Is there a triple point, that is a temperature and volume at which all three phases of a substance—gas, liquid and solid—co-exist? Are there temperature-induced points of brittleness? Personal experience tells us money's behaviour is not dissimilar.

How does a banker or financial expert construct and think about earnings, and so loans?

EBITDA suggests it could be akin to how scientists think of pressure. Both a point in time and space, and the culmination of many factors. Perhaps also as the politician thinks of an election result. A number on the day resulting from many inputs of varying and overlapping scales. Just as the pressure of a system determines its sustainability, coherence and resilience across a range of conditions, so do earnings determine corporate or organisational viability.

Each term in EBITDA can be examined, as with calculus, range limits, stats, sample size and content analysis one evaluates experimental results before publication. And each term can be

CONTINUED ON PAGE 13

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enhanced or diminished by science and politics, practised domestically, nationally, regionally and internationally. Again for the moment do not yet consider how ethics should be applied.

Earnings in EBITDA, that is the operating profit, are, of course, the expenditure needed to operate a business on a daily basis. The operating profit does not include such things as tax, interest on loans, or the amount one is allowed to offset against tax following purchase of a business asset, be it a building or a patent: ie, depreciation (former) and/or amortization (latter).

That is, the earnings in EBITDA are what is left after spending money on what executives of the organisation have told their respective Revenue Services was the task/suite of tasks they were undertaking to generate revenue with intent to make profit. Taken as a whole EBITDA allows comparisons of like with like.

In other words a hydroelectric plant and coal-fired power station generating the same number of Gigawatts have different operating profits because they buy different things to accomplish their task. Operating profit isn't confused by costs such as carbon offset trading—at least I don't think in accounting terms it is meant to be, because that cost is created after, and not before the fact.

Instead, what the Cabinet of your nation-State has before it is a comparison of apples before the application of politics, human need, ecosystem welfare, resource management, international diplomacy, national politics and legacy situations, because the previous Party in power had a particular constituency which had to be placated, else the Country would have imploded.

### **ENTER SCIENCE: STAGE LEFT**

If scientists combed through a break down of purchases of the two power stations they might find cheaper ways to accomplish operational tasks, and so increase operating profit. For the purpose of this exercise that cheaper cost would ignore whether the cheaper method damages the environment or incurs downstream cost – unless there is law to the contrary. However, just as when annotating a genetic sequence, it would help to annotate the budgetary line item.

There is another term to be aware of, but to ignore in this analysis, and that is working capital, meaning the current assets minus current liabilities of your existing or planned utility. That concept engages with collateral. Lenders look for reassurance they will be repaid by looking, among other things, at the collateral's resilience and liquidity (ease of selling). In this exercise I am asking science and politics to understand, analyses and optimise only terms in EBITDA. Operating profit does not include paid for assets, though they can impact profit.

### **BALANCING THE EQUATION**

Earnings (operating profit), then are the left hand side of an equation. On the right there is net profit, that is profit after all business deductions, tax, interest, depreciation and amortization. Ignore net profit. One can ignore the net profit because interest, tax, depreciation and amortization are being added back in to the mix by the EBITDA formula. In those circumstances a net profit breakdown ought not to give more information than the operating profit accounts.

At this stage don't worry about which bank might lend the money.

Move now to the column for interest, comprising interest on all loans and lines of credit.

**INTEREST**

Interest in EBITDA is on combined long, medium and short term loans. This is the term where increasing operating profit by good science could make lending attractive for infrastructure.

Let's imagine, for example, your country specifically wants to extend its grid, is there anything science and politics can do that makes attractive an alteration in the length of time over which existing loans are repaid? These loans might be those which financed earlier work on the electricity grid or gas pipelines your country now wants to extend so that more people access modern, efficient energy for refrigeration, heating etc... The aim is to restructure interest so that the lender earns back everything it was agreed in the first place would be paid.

Undertake this exercise irrespective of whether an overwhelming case for debt relief exists because of unpredictable events which even the most diligent could not have guarded against.

One way to justify altered interest rate structure on a suite of loans would be to shift increases in operating profit into a large (as large as possible) early repayment of interest on the principal. Get ahead of yourself in paying interest, while paying back the principal at the same steady rate. The financial institution can put early interest repayment to work, and the next year you go back to the agreed interest payment on the principal. In parallel the Ministry for Power is planning, say, a mini-grid to reach good sized pockets of population without access to power.

A year or possibly more after your early repayment of interest you take out another loan equal to the size of your early interest repayment, plus some of the interest which the lending body earned with your early interest repayment. The financial institution gets to keep the rest of whatever interest it earned from your early repayment. Overall the bank is not losing interest, makes a profit, and the principal is being paid back at a steady rate.

**SCIENCE AND POLITICS CONTRIBUTES**

The operating profit increase fuelling this loan restructuring could come about because science identified transmission or generation loss reductions. Politicians could legislate to ensure utility companies are paid for power sold. So ideas in blogs and the literature might help. Just make sure they are read!

Circumstance could mean a financial body cannot responsibly absorb large early repayment of interest. Even knowing a deal might be in the offing could make commercial banks vulnerable. Are there reasons the World Bank cannot remain stable through significant varied cash flows?

**TAX AND DIPLOMACY**

If interest restructuring were agreed with financial institutions, law would have to allow transfer of extra profit directly into early loan repayment, rather than additional tax revenue. Tax payers or shareholders might not like the idea. But if future tax receipts resulting from market expansion are predicted, then not getting a windfall tax one year might be ok. As well as expanding a future economy, a mini grid, for example, electrifying a new part of the country, could meet the humanitarian goal of reducing energy poverty. That might enhance political stability, and even remove causes of local unrest, or possible civil War. Then again, certain groups might not like that peaceful prospect. Hence the need for science to cede to politics.

Together science and politics exchanging information without trying to influence one another's remit, acting, in other words, like a board of directors, could leverage each others' competence. Politics, probably, would have to decide which body undertakes the function of chairperson. Parliament? Law? Referendum? Electorate? Executive?

### DEPRECIATION AND AMORTIZATION

These two terms deal with the decreasing value with time of physical and intellectual property. Both can be difficult to parse and value. Tax authorities intermittently intervene and say how a purchased asset may be claimed as an allowable expense against tax on net profit generated. In doing so they separate amortisation and depreciation on a tax return from intrinsic value. Thus there can be a separation between asset value on a corporate balance sheet and its amortized and/or depreciated value on a tax return.

The governmental act specifying depreciation and amortization allowed on a tax return applies financial brakes which can prevent an economy spiralling out of control. Clearly, though, some assets keep their value and/or appreciate in value long after they are no longer a tax deduction. The flip side of the coin is that the value of the partially depreciated/amortised asset may loose value because it is overtaken by more efficient technology, or technology cheaper to maintain.

In this article the depreciation and amortization are for analysis in the framework only of EBITDA when a country, region or their agents seeks finance for a significant capital project to enhance national energy-generation, transmission and distribution infrastructure. The question is: can science and politics optimise the value of an existing asset which is currently being depreciated or amortized on a tax return so that the asset is more attractive to a lender. How a fully amortised or depreciated asset looks to a lender is a different question, which properly belongs more to politics informed by science, than to science leveraging sustainable finance.

Also, since the value of an asset may be greatest, and have the greatest possible (unseen n the books) leverage on operating profit once the asset is fully depreciated or amortised, both science and politics need to assess the borrowers' assets.

What is the purpose of the asset? Operational reliability or maximum revenue generation, for example. Has an alternate come on the market that means selling the asset before fully depreciated will maximise operating profit? Is that because profit generated will exceed the tax deductible by the not yet fully amortised/depreciated asset? This kind of analysis could provide the profit surge which, if the legislative and diplomatic pieces are in place, would allow a company/municipal authority or country to make an extra payment on its existing loan interest in order to borrow more money. And this is where ethics enters. Should it?

### A FORMULA FOR THE WORLD OF BONDS

EBITDA, therefore, is not a tool to guide stock market investing, but is a formula belonging in the world of bonds, diplomacy, international politics and national politics red in tooth and claw. If understood by science which, in its bones and DNA, is co-operative and international (that is, when not competing to publish in high impact journals), then science could leverage the term. But I can think of no circumstances in which science must not cede to politics and government-controlled diplomacy in efforts to implement findings from such analysis.

## FROM THE CHEDDAR GORGE TO ROCKETS & RURAL INDIA

The Central Electricity Generating Board still existed when I started covering energy as a journalist and editor in the 1980s. For the first 10 years of my career energy was one of the main topics I covered. My one and only effort in those 10 years on staffs to sell a freelance story was to the *Financial Times*, to David Fishlock, the then energy editor.

Early in my journalistic career I interviewed Professor Ian Fells about magneto-hydrodynamics. Professor Fells is a stalwart of the BBC Today programme, and from the University of Newcastle. When the Piper Alpha disaster happened when I was Technology News Editor at *New Scientist* Professor Fells was a great source about North Sea oil pipelines and their vulnerabilities, as well as an excellent contact on nuclear issues.

From London to the House and Senate Congressional Committee rooms of Washington DC was but a short step for me. There I witnessed elected representatives grill (as they continue to grill) public officials and private industry about energy policy, expenditure and plans. They take energy infrastructure seriously in Washington DC.

In England I watched a train crashed deliberately in the Cheddar Gorge to test the robustness of transporting nuclear waste. In Washington DC activists worried about nuclear-powered spacecraft re-entering the atmosphere, and the geological stability of nuclear waste disposal sites. One of the novels I have plotted, but not written, is a mystery about buried nuclear waste discovered in a distant future.

At the time the Anthropocene debate was unheard of.

In Israel I visited scientists working on the energy conversion efficiency of solar cells. In northern Vietnam, when I was there, Electricity was still far from widely available, though I and others were given a pass to leave Hanoi and visit a dam for hydro electricity. Bomb craters still pock-marked the Countryside.

And it is nearly 30 years since I was in Bangalore in India for the International Astronautical Federation meeting. The hotel I stayed in was designed to attract business people. I saw little of the country's energy infrastructure. I did see beggars in the street and a Statue of Queen Victoria. The argument about space being a waste of money was repeated frequently. I noted, of course, the discrepancy in southern India in the late 1980s between facilities during my visit to interview the director-general of the Indian Space Research Organisation (ISRO) and the pre-industrial transport I encountered on leaving Bangalore at the end of the conference to visit Mysore. There I mingled with crowds celebrating one of the great Hindhu festivals. En route the taxi had competed for road space with slender Oxen, pulling what looked like rickety carts.

Though now I have a Smart Phone, and then had only uncertain telephone lines over which to file copy with the news desk in London, I am not convinced the world has, in the intervening 30 plus years, grasped the central position of energy for equitable life and development. Without meeting the energy goals I do not see how any of the United Nation's seventeen 2030 sustainable development goals are to be met. **HG**

**With feedback from deputy editor, Martin Redfern.**

## Heavy hitters in virus research probe ZIKA's secrets

By Helen Gavaghan\* relevant professional biography

ON 3<sup>RD</sup> JANUARY, 2017 THE *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES*, A WORLD LEADING JOURNAL IN INTERNATIONAL SCIENCE, PUBLISHED A MASTER CLASS ON RESEARCH INTO VIRUSES, WRITTEN BY US AND JAPANESE SCIENTISTS. THEIR TARGET WAS, AND IS, THE ZIKA VIRUS, A PARASITE WHICH CAN HAVE CRUEL CONSEQUENCES. THE WORK APPEARED A MERE NINE AND A HALF MONTHS AFTER AN ARTICLE IN THE *NEW ENGLAND JOURNAL OF MEDICINE* AUTHORITATIVELY ARGUED THERE IS A CAUSAL LINK BETWEEN PRE-BIRTH MATERNAL ZIKA INFECTION AND CONGENITAL DEFECTS. IMPORTANTLY NOT ALL SUCH MATERNAL INFECTION CAUSES BIRTH DEFECTS. THE STAGE OF THE PREGNANCY WHEN INFECTION OCCURS SEEMS RELEVANT\*\*

### A quote for politicians:

*"Viruses are extremely small (20-300nm) parasites, incapable of replication, transcription or translation outside of a host cell." P265.*

### A quote for scientists:

*"It is important to realise that viruses do not exist ... to cause disease, but simply because they are able to replicate." P267.*

**Instant notes in molecular biology (1997). Bios Scientific Publishers**

When it comes to names that reverberate in the international world of science, medicine, and biomedical research, Robert C. Gallo MD, tops the premier league. His work in the early 1980s co-led identification of and the fight against HIV and AIDS.

Put simply, this means on learning Gallo had contributed a paper to the *Proceedings of the National Academy of Sciences (PNAS)* about the ZIKA virus, and where and how its proteins affect an infected host cell, only one thing could follow for anyone serious about keeping up to date with viruses in medicine. The paper, by Li *et al*, had to be read. The results he and his colleagues are reporting - which were reviewed pre-publication by the best of the best - are a critical part of knowledge-building needed to fight Zika infections in people of any age.

Both viral and host-cell biology are needed by all viruses for replication, Zika included, and replication occurs inside an infected host. This study showed that Zika's proteins are found in the host cell sub cellular locations one would have expected, given what is known generally about the biology of viral replication, and the structure predicted for Zika's proteins from the virus's genetic sequence.

In viruses, proteins are structural and non-structural. In this context, structural means part of viral architecture, its capsid (outer shell), for example. The non-structural components are those playing a part in the processes of the viral life cycle.

Emphasis in the *PNAS* paper is placed on non-normal consequences of Zika infection. That is, the paper reports cytopathologies noted following controlled infection of host cells with Zika. Pathologies of interest in viral infection include: cell dysregulation, cell hypertrophy - where the cell is excessively large, cell proliferation, apoptosis, and cell death triggered by oxidative stress. Host cell irregularities exist in illnesses and birth defects associated with Zika infection.

The researchers are interested also in the impact of Zika on a process known as autophagy, in which cell content - both its architectural structural lipids and proteins, and its “worker” proteins orchestrating the cell cycle - are digested by enzymes of the same cell. Think of autophagy as the orchestral score, and Zika as an unwelcome band joining the performance, highjacking the bassoons, say, and integrating its own music in both seeming harmony, and dissonance.

Though the paper by Li *et al* dives deeply into basic science, and into fast-moving, newly-uncovered scientific insights, it is human medical need which drives the research. Human surrogate cells were needed to conduct a genome-wide analysis of the Zika viral proteins, their subcellular locations, and functional impact. Genome-wide analysis simply means locating each protein coded by a genome in relationship to that genome as a whole.

Li *et al* chose the fission yeast *S. Pombe* for their study. It is a single-cell eukaryote, with a biological nature allowing experimental findings to be extrapolated to the human biology.

For the insatiably curious a eukaryote is any organism with a cell nucleus bound by a plasma membrane, and that covers a large portion of biology on Earth, from unicellular organisms to mammals. Zika is a positive-sense (meaning DNA and RNA in the same direction), single-stranded RNA virus of the flavivirus family. It has some aggressive viral “cousins”, such as dengue virus, and the family is responsible for several unpleasant medical conditions.

Zika hit the headlines in 2015 following an increase in infections in Brazil. In September of that year some of the babies born to women who had had pre-birth Zika viral infection were noted to have abnormally small heads (microencephaly) and other brain anomalies. Medicine sometimes applies seemingly inhuman language like anomaly to avoid the harm of using precise language incorrectly, which could be dangerously misleading, overly prescriptive, or premature.

Then in April 2016 *The New England Journal of Medicine (NEJM)* published a paper arguing authoritatively that there is a causal link between prenatal Zika viral infection and congenital defects. The arguments are complex, and do not mean pregnant women infected with Zika will have a child with microencephaly. They do mean that avoiding mosquito bites is a good idea, as is consulting a doctor about when in the pregnancy Zika infection occurred.

Zika is also associated with the auto-immune disease - Guillain-Barré syndrome, which can occur at all ages.

Confirmation of a causal link between Zika viral infection and congenital abnormalities in babies born to women who had been infected with Zika is only the beginning of the fight back against Zika. It is a confirmation which, not unusually, reveals the chasm between medicine and science. Following the *NEJM* publication of April 2016, medicine has become sure footed. Science is on slippery ground. The two need to be in sync, and at the moment they are not.

Li et al write,

“Given the number of host cells and viral variants [of Zika], it has been difficult to identify the pathogenic factors and to generate a consensus on ZIKV [Zika virus] protein functionality.”

This was the research team’s starting point.

As with HIV in the febrile research days of the early 1980s surrounding identification of its role in AIDS, Zika and its pathology are poorly understood. Then Robert Gallo and others clashed via publications in high-impact international scientific journals as they raced - literally - to understand AIDS and its causes.

Since then biomedical research techniques have undergone revolution after revolution. Each year billions and billions of dollars are spent on biomedical research, and that is in the US alone. In the January, 2017 *PNAS* paper by Li *et al*, which Gallo contributed to *PNAS*, Li *et al* deployed many techniques honed in recent decades including: plasmids, clones, shotgun cloning, vectors, RT-PCR, post-genomic analyses, transfection, green-fluorescent proteins (GFP) bonded to the protein of interest etc...

### **LI *et al* TAKE ON ZIKA**

What follows is what Li *et al* did, what they found out, and their informed view that their findings can leverage future Zika research.

First, they selected *S. Pombe* because it has critical biological attributes akin to human cell biology, as well as biological pathways for a number of functions which are similar in mammals. That is, *S. Pombe* is a so-called model organism. While no model organism can be an exact surrogate for a human or some other species’ biology, in the circumstances of this research *S. Pombe* ticked relevant boxes.

Working with old and new techniques, the researchers explored cell pathology resulting from Zika infection. They experimented on whole *S. Pombe* cells, alone and in colonies. One strain was a wild type, another way of describing naturally occurring organisms. Two others were mutant strains selected for the metabolic path they influence, which made them useful for probing one aspect of cytopathology in Zika-infected host cells. Agents (plasmids and vectors) carrying just the genetic material needed to express the proteins they wanted to observe in the host system were recruited.

Having decided which surrogate organism to work with, Li *et al* localised Zika’s proteins in *S. Pombe* cells. Zika codes for 14 proteins. To visualise locale they fused the genetic code for green fluorescent protein (GFP) with that of each viral protein. The whole was placed in a gene expression vector, and the vector carried the protein-expressing genes into wild type *S. Pombe*. Fluorescent microscopy identified where the 14 proteins positioned themselves in the cell.

Though Zika viral proteins located themselves in *S. Pombe* in the position one would expect,

Continued on page 21 | 19

## WOMEN IN SCIENCE: 26<sup>th</sup> November, 2016 to 24<sup>th</sup> February, 2017

### December 2016

France Córdova, director of the US National Science Foundation, rounds up science highlights from 2016 in her monthly Director's Notes.

[http://us12.campaign-archive1.com/?u=e565a96b120cd217183307476&id=132b67ed4f&e=\[UNIQID\]](http://us12.campaign-archive1.com/?u=e565a96b120cd217183307476&id=132b67ed4f&e=[UNIQID])

Her picks for importance include: detection of gravitational waves from the merger of two Black Holes; the 60th anniversary of the US having a science base at the South Pole, and construction in Chile of the Large Synoptic Survey Telescope

### December 2016

The Royal Institution (If you live in the UK, these are the folks who put on the splendid annual Christmas Lectures) thank Her Majesty Queen Elizabeth II for work over 64 years as their Patron.

### 11<sup>th</sup> January 2017

Keen watchers of the American Association for the Advancement of Science (AAAS) learn that emeritus professor of biology, Margaret Werner-Washburne, is to receive a life-time achievement award for mentoring, and increasing the number of hispanic and native American doctorates in biology.

<http://www.aaas.org/news/margaret-werner-washburne-wins-aaas-mentor-award-lifetime-achievement>

### 20<sup>th</sup> January 2017

Dr Sarah Teichmann (41), head of cellular genetics at the Wellcome Trust Sanger Institute in Cambridge, wins a £20,000 Helmholtz international Fellowship Award for her research. She works with single cells on the global regulation of gene expression, and on the development of single cells and cell types. See Zika feature on p17 of this issue for the story of work -- not related to Dr Teichmann's - which demonstrates the importance of understanding single cells, cell types and their development.

### February 2017

Of 1614 current Fellows of the Royal Society, 130 are women.

For other statistics visit:

<https://royalsociety.org/fellows/fellows-directory/>

In 2016, fifteen women were elected FRS or ForMemRS (Foreign member) compared with 45 men.

### 22nd February 2017:

The European Federation of Pharmaceutical Industries and Associations (EFPIA) today announces Nathalie Moll will become the organisation's new director general in April 2017. EFPIA represents the pharmaceutical industry in Europe, which is working on human medicine. Ms Moll is currently secretary general of the European Association of Bioindustries.

Continued from page 19. This section is for this quarter given over to the Zika feature.

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given their structure, the expression level and timing of expression influenced the location of some of the proteins. Interestingly at high expression levels all Zika proteins formed small speck-like bundles, some of which resemble a cell structure, called a cytoplasmic puncta. The scientific literature shows that such puncta are often associated with cellular autophagy when it is linked to cell or oxidative stress. In their discussion the researchers write,

“Because viral infection of cells could produce both low and high levels of proteins, depending on the degree of viremia, the formation of these accumulated protein specks potentially could be relevant to the severity of ZIKV infection.”

To gain insight into the impact of Zika viral protein on cell growth and toxicity the researchers next studied *S. Pombe*'s behaviour as a colony. Seven proteins inhibited colony formation. That observation led to colony-growth kinetic studies. Of the seven proteins, some were linked to almost total inhibition, and others to reduced growth.

Drawing on plausible biology and findings in the literature, the study grew more specific in the questions it asked and answered. Each of their conclusions and observations asks as many questions as it answers. There is a saying in English, “to open a can of worms”. The saying means that the answer to an innocently posed question can lead to much more complexity than the asker bargained for. That is what localising Zika proteins in *S. Pombe* has done for Zika viral research. It has opened a can of worms, which is probably exactly what was intended.

Though undertaken with significant medical input and biological plausibility, the PNAS paper is science, not medicine. It is the cornerstone of the science that medicine is going to need in understanding Zika virus and its impact on people. Built on a bibliography of 85 science papers in the high calibre scientific literature, the PNAS paper takes diverse information and filters and focuses it into an informal “invitation for proposals” across a range of related and inter related disciplines. As is the case so often in the elite literature of *Science*, *Nature*, *Cell*, *PNAS* or the Royal Society journals, this paper is like a watershed. Many primary and separate waterways flow into this paper, and many might flow out, of which one could be circumscribed by Zika and its relationship to people and those mosquitoes which spread Zika far and wide.

“These findings should provide a reference for future research on the prevention and treatment of ZIKV diseases,” write Li *et al.*

The researchers listed on the 3<sup>rd</sup> January, 2017 paper in PNAS are from the University of Maryland and the RIKEN Center for Sustainable Resource Science in Japan. The full name of *S. Pombe* is *Schizosaccharomyces Pombe*.

### **\*\*WARNING**

Be wary of information, even from official sources, about travel and other advice concerning Zika. Information can change quite quickly. Take a print out of official advice about Zika in the context of travel and/or pregnancy and check with your doctor.

This section is given this quarter to the Zika feature. Continued from page 21.

#### BIBLIOGRAPHY FOR THE ZIKA FEATURE

[1] **Characterisation of cytopathic factors through genome-wide analysis of the zika viral proteins in fission yeast.** *Proceedings of the National Academy of Sciences*. Early edition. 3<sup>rd</sup> January, 2017. Ge Li *et al.* [www.pnas.org/cgi/doi/10.1073/pnas.1619735114](http://www.pnas.org/cgi/doi/10.1073/pnas.1619735114)

[2] **Zika virus and birth defects - reviewing the evidence for causality.**

*N Engl J Med* 2016; 374:1981-1987 May 19, 2016 DOI: 10.1056/NEJMSr1604338

Published online 13<sup>th</sup> April. 2016. *New England Journal of Medicine*.

[http://www.nejm.org/doi/full/10.1056/NEJMSr1604338?query=featured\\_zika](http://www.nejm.org/doi/full/10.1056/NEJMSr1604338?query=featured_zika)

Accessed 31st March, 2017.

#### ACRONYMS used in the literature cited above.

EMM: Edinburgh minimal medium.

GI: Gene induction.

mTOR: mammalian target of Rapamycin.

nmt1: No message in the thiamine.

NS: Non-structural (protein). In this context, non-structural means proteins *not* building a structure, such as the virus capsid (outer barrier), but rather a protein involved in facilitating the viruses' activities.

YES: Yeast extract with supplements.

#### FURTHER READING

[https://talk.ictvonline.org/ictv-reports/ictv\\_online\\_report/](https://talk.ictvonline.org/ictv-reports/ictv_online_report/)

**Virus Taxonomy: The Classification and Nomenclature of Viruses The Online (10th) Report of the ICTV (2017)**

ICTV is an acronym for the International Committee on viral taxonomy. Their website is <https://talk.ictvonline.org>

Accessed 28<sup>th</sup> March, 2017.

**Robert C Gallo MD**

<https://www.umaryland.edu/champions/robert-gallo/> Accessed 28<sup>th</sup> March, 2017.

#### BACKGROUND READING

Below is my selection as editor of articles for those wanting to go more deeply into the science behind the different tools and developing knowledge sets assembled by Gallo and his colleagues in their focussed (and competitive) effort to pry open the research field of how Zika virus proteins cause cell hypertrophy, cell death, cell dysregulation and growth restriction in cells. These are all aspects of cell cytopathy, and they are seen in the cells of people infected with Zika virus, though, of course, in the normal course of events cell death is simply part of a cell's life.

**A: *S. Pombe*** (2013).

Development of episomal vectors carrying a nourseothricin-resistance marker for use in minimal media for *Schizosaccharomyces pombe*. First published 20<sup>th</sup> May, 2013 in *Yeast*. <http://onlinelibrary.wiley.com/doi/10.1002/yea.2955/full>

**B: rapamycin** (2012). mTOR-Dependent Cell Survival Mechanisms

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3504431/> *Cold Springs Harbor Perspectives in Biology*.

**C: Viral vectors** (2009). Viral vectors: from virology to transgene expression.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2629647/> *British Journal of Pharmacology*.

**D: Fission yeast growth rate.**

Measuring the growth rate of fission yeast. An example of what science students do, from San Francisco State University. <http://online.sfsu.edu/pasion/bridges/Exercise12.pdf>

**E: Guillain-Barré syndrome.** From the US NIH website.

**F: Whole genome shotgun sequencing.** Cold Spring Harbour oral history in which Dr Craig Venter talks of the approach in the context of smallpox, and the intellectual debt he the sequencing field owe Fred Sanger.

**Helen Gavaghan** founded, publishes (as Gavaghan Communications) and edits *Science, People & Politics* (ISSN 1751 598X), working with the advice and co-operation of journalist colleagues who are co shareholders in the dormant company owing the title, and with editorial advisors. She has worked on staff, as freelance, or on retainer for most of the international science press, has been history consultant to the IGO, EUMETSAT and a content consultant for the London Science Museum, and the magazine Telecommunications Development Asia Pacific, and was editor of the international medical devices and diagnostics newsletter, *Clinica*. Helen Gavaghan won an Alfred P Sloan Foundation scholarship [New York, \$125,000.00 in 1992], researched and wrote an authoritative history of early application satellites, which is published by Springer Verlag (New York). She is a former technology news editor and Washington Correspondent of *New Scientist*, former UK correspondent for Paris-based *Biofutur* and *Le Journal Internationale de Medecin*, and former Washington DC-based biomedical research policy correspondent for *Nature*. She has a BSc honours in biophysics from the University of Leeds (1976-1980), and studied the history of science, technology and medicine as a post graduate research student at the University of Manchester 2002-04.

## COMING OFF THE GOLD STANDARD CAN GET THE JOB DONE

By Helen Gavaghan\*

In the world of drug development the randomised, double-blind, placebo-controlled clinical trial has long been considered the most professional way to complete the process of getting a drug to market. It is often referred to as the “Gold Standard”. Yet it can be a crude tool. In the February 2nd 2017 issue of the *New England Journal of Medicine* Richard Moscicki MD, from the US Food and Drug Administration’s Center for Drug Evaluation and Research, outlines with a Ph.D colleague from industry examples of alternate regulatory strategies for drug approval. Their context is mainly innovative product development by small companies.

Sometimes it is the ethics of the situation, sometimes the nature of the disease, or advances in ability to identify subgroups as appropriate therapeutic targets which prompts regulators to accept an alternate to the “gold” standard in a drug development strategy.

Take the rare disease, Pompe. In 2006 the US FDA authorised a treatment known as Myozyme for clinical use. During the regulatory process instead of administering placebo to a control group, the researchers reviewed medical charts to locate an historic cohort matched for age and the treatment options available to the historic group. There were 18 patients in the trial who were being compared with the retrospectively identified control group. A large positive effect was observed in those (babies) administered Myozyme. On the basis of that 18-patient group and those findings the US FDA approved the drug.

Ethics drove selection of the trial strategy because early clinical trials (which would have been the ones dealing with such issues as teratogenic effects, for example) had suggested the trial drug could help the babies otherwise very likely to die before their first birthday. The drug is the product of recombinant DNA. In Pompe’s disease there is a deficit of a normally occurring molecule, known as acid  $\alpha$  galactosidase (GAA). GAA breaks down lysosomal glycogen into glucose for energy. In GAA’s absence glycogen accumulates in muscle, leading to cardiomyopathy, hypotonia and generalised muscle weakness.

Other alternates to the “gold standard” include: identifying a surrogate endpoint to enable a more homogenous and smaller patient subgroup (it helps to have identifiable clear phenotypes); and identifying a genetic marker indicating those patients most likely to benefit from a therapy seeking regulation. Drs Moscicki and his industry co-author describe how these approaches to drug development have been examined and applied at the FDA. **HG**

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Drug-Development Challenges for Small Biopharmaceutical Companies. Richard A. Moscicki, M.D., and P.K. Tandon, Ph.D. 2nd February 2017. *N Engl J Med* 2017; **376**:469-47 DOI: 10.1056/NEJMra1510070

Among other things Helen Gavaghan is former editor of international medical devices and diagnostics Newsletter, Clinica, former Washington-DC biomedical research policy correspondent of Nature, former US correspondent for Le Journal International de Medecin, and former UK correspondent for the Paris-based magazine, Biofutur.

## Forensic Science Regulator calls for adherence to standards and vigilance

IN JANUARY 2017 OF THIS YEAR THE FORENSIC SCIENCE REGULATOR FOR ENGLAND AND WALES RELEASED HER SECOND ANNUAL REPORT. DR GILLIAN TULLY'S AIM REMAINS THAT FORENSIC SCIENCE BE OF THE REQUIRED QUALITY FOR THE CRIMINAL JUSTICE SYSTEM. HER 46-PAGE REPORT IS MINDFUL OF BOTH DEFENCE AND PROSECUTION NEEDS, AND OF THE RIGHTS OF VICTIMS AND DEFENDANTS IN THE CRIMINAL JUSTICE SYSTEM OF ENGLAND AND WALES.

**By Helen Gavaghan**

Standards. It's all about standards. That is the message writ large by the Forensic Science Regulator in her annual report to November 2016, and published 6<sup>th</sup> January 2017. In her foreword, Dr Gillian Tully (Ph.D), writes,

"To be clear, the standards are not some unachievable 'gold-plated ideal....".

When Dr Tully writes forensic science, it is her short hand for forensic science *and* forensic pathology.

### A RISK ACROSS THE BOARD

Between November of 2016 and April 2017 more than 60 percent of the outsourced market by value is up for tender, or to be transferred to a new provider. That, in Dr Tully's view, is a general risk factor faced by forensic science

"Experience has shown that when large volumes of work change hands, there is an increase in quality failures and a loss of skills," says the report, and vigilance will be needed in light of provider changes.

Not only market-place changes confront forensic science. By October 2017 police are meant to comply with the Forensic Science Regulator's Codes of Practise (the codes) for digital forensics. In 2018 forensic science within policing must comply also with the codes for fingerprint comparison, and by 2020 with codes for scene-of-crime activities.

At time of publication the Regulator's view of digital forensics compliance with the codes was,

"...the indications are that few organisations will attain the required scope of accreditation by October 2017".

Dr Tully argues Statutory Powers are needed to "induce" compliance by those organisations which have not committed the necessary resources to attain standards set for digital forensics.

Firearm classification has also caught her eye, and she points out the risk of incorrect classification of some weapons remains, though she does not go in to detail.

The report points out an audit in 2015 reviewing alleged rape cases showed,

“... a risk concerning the level of training, skills and experience of personnel within policing making initial evaluative strategic decisions”.

Specifically, Dr Tully points out not all procurement of forensic medical examiners specifies “the appropriate level of FME training and qualification.”

A more extensive audit is needed, she writes.

Alleged rape cases, of course, frequently rely on the quality of the DNA evidence, though it is not only alleged rape in which genomic data are critical.

When it comes to DNA, minimising the risk of contamination or the existence of unidentified DNA matters to both defence and prosecution.

Elimination databases are needed to prevent miscarriages of justice. Expanding such databases to include DNA from all who might have come into contact with the resources used in an investigation is ongoing.

At the time this report was published the question of whose DNA would be included in elimination databases remained a vexed question, which had grown to envelop trade union officials and issues of privacy.

In her report, Dr Tully says forensic science organisations have for some years operated elimination databases of their staff and some police staff so that those with potential to contaminate a forensic sample will not be incorrectly uploaded to the National DNA Database.

During 2016 progress was made with a Central Elimination Database.

The project aims to include DNA from police officers, police staff, staff of organisations “manufacturing consumable items used in the DNA profile process”, as well as from forensic medical examiners and relevant staff at Sexual Assault Referral Centres.

High priorities for the Forensic Science Regulator in 2017 are: digital forensics; casework review; operational implementation of streamlined forensic reporting and casework management; evaluative interpretation of standards (essentially an exercise in getting everyone to understand the same meaning of the words); firearms classifications; standards for custody suites and the Sexual Assault Referral Centre; supporting expansion and implementation of the Central Elimination Database; DNA mixture guidance, including software validation; conduct annual forensic pathology audit; provide ongoing support adoption of a fingerprint comparison standard; continue developing less expensive means of small businesses meeting required standards; and support bids within research areas prioritised within the report.

Medium priorities are: clarify quality requirements for infrequently used methods and experts; work with professional bodies to complete standards for forensic podiatry and forensic

## DONKEY RIDING COMUMN: JUSTICE IN THE DARK

Law is not science, nor is it medicine. The starting point in the Crown Court of England and Wales is that no matter how overwhelming the evidence, the defendant is innocent until the prosecution proves otherwise. That is, the null hypothesis is: the defendant is innocent.

Likely motives are irrelevant; narrative context anathema. Can the evidence be explained some other way is a valid question. Murder is not an epigenetic biochemical phenomenon, which can be understood differently depending on the physiological entry point. Murder is murder, unless it is manslaughter, or accident, or suicide, or self-defence, or lawful defence of another. The Crown Prosecution Service determines the charges.

Evidence is sufficient unto itself, and its relationship to fact is complex, as is the meaning of fact. When it comes to scientific or medical evidence the context is a siren call which can lure the scientist or doctor to embarrassment, or worse.

That there is no burden on a defendant to prove their innocence is something I have now heard every single defence counsel I have seen in action tell the Court. It matters to recall that the scientific and medical evidence are only a small part of what is presented to the jury. Family pains, children, relationships - the stuff of life, even when Court Orders under one of the Youth and Criminal Justice Acts are not made - do not always make it into the journalist's copy.

The lives wrecked, irrespective of the defendants' guilt or innocence, are not, in the Crown Court, the story. It is the act itself. How overwhelmingly plausible is it that the accused must have committed the crime, even if the act was not seen, odd seconds of evidence are missing, or the murder weapon not found? Is there sufficient evidence to justify a jury concluding the accused had murder in their heart, and knew that, given the existence of certain weapons, murder might well be committed?

To students of law the news reports, transferred from the publisher's website where they appeared contemporaneously, to pages 28-30 of this issue, are the tip of an iceberg which is their discipline. To scientists the point of these two news reports is that science is a tiny part of justice. It is a servant, and it is subservient. To politicians of any nation the two news reports beginning on page 28 speak of tragedy of Shakespearian proportions.

Fellow journalists undertaking court reporting from English and Welsh Courts will recognise the legal landscapes plausibly shaping the proceedings leading to the jury's retirement.

And now to the criticism. The Courts are not the private property of those who work there. Open justice, I argue, means evidence should be presented so that justice may be seen to be done. In the case I report on pages 28-30, having sat through 17 days of defence, closing speeches and the judge's summary of evidence, and legal directions, I did not once see some of the evidence of great significance, namely the video footage. None of my fellow Press seemed to think the Court set up inappropriate. I think it was.

Equally important, only a few of those in the public gallery, who included the officer-in-the-case, could see the video evidence as it was presented to the jury, and then only at an extreme oblique angle. I suggest also that that is wrong.

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Five mens' freedom was at stake. Another man had died a painful death, another's lung was punctured, yet another was injured. A family at one with one another for a hundred-plus years lay shattered. Purportedly much of the video evidence was shadow which might have been that of one, or of several men at different times. It was dark. Huge efforts had been made to decide in agreed evidence prior to trial who each of the figures on the video must be given known events uncontested by all parties. Yet Press saw non of this evidence. I am not saying the police were wrong, not that the prosecution - of distinction and integrity - did not do his job honourably. And I most assuredly take off my hat to the five silks and their juniors who painstakingly dismantled the prosecution's case of joint endeavour murder by five brothers.

What I am saying is that to me it is astonishing that the Court let me and - intermittently - other members of the Press sit there and did not instinctively say - make this evidence visible to Press in Court. Put a screen where the Press can see what is happening. That way the reporter's in Court would be able to put an end to many a false rumour. That way, too, the public can exercise freedom of speech if what we as Press report causes them concern. **HG ||**

### **UKSC judgement: a Crown act of State**

“So what is this doctrine of Crown act of state?”

**Judgement given on 17th, January, 2017. P3 [2017] UKSC 1**

The UK Supreme Court's first judgement of 2017 explored the doctrine of a Crown-act-of-state. The Appellants—the British Government—had deployed the rarely invoked and rarely successful defence concept in actions brought against the Ministry of Defence and Foreign and Commonwealth office under Iraqi and Afghan law of tort. The Respondents are people suing in the context of the Respondents having been detained by the British during recent conflicts in Iraq and Afghanistan. In the cases covered by this judgement the justices upheld the Appellants.

Though reaching back to the 13th century, and quoting from 18th, 19th, 20th and 21st Century case law, from academic references, and calling on Blackstone and Halsbury's Laws of England, the Justices do not precisely define the doctrine. Nor do they tie down related concepts such as justiciability (one way of thinking of justiciability is whether certain factors place an act outside the scope of British courts) and the impact of the doctrine of Crown-act-of-state and of justiciability on liability in tort law. They cited UK Statutes defining an evolving legal landscape.

The justices did, however, say what attributes should or could be present if something were a Crown-act-of-state. The non-comprehensive, non-definitive list includes: the act would be Sovereign, governmental in nature, approved before or subsequently ratified by the Crown, committed outside the UK, part of the conduct of foreign policy of State, necessary in pursuing that policy, extending to military action (probably). Military actions would be lawful in international law, even though military action lawful in international law is not necessarily one authorised in international law. In various combinations the justices deployed different arguments in support of their unanimous finding for the Appellants. Two related judgements were also handed down [UKSC 2 and 3] on 17th January, 2017: they address a defence of state immunity and foreign act of state [UKSC 3] and relationship to Article 5 of the Human Rights Act 1998 [UKSC 2].

Legal decision making is ongoing. **HG ||**

The next two reports, published on the same day as, respectively, the verdict and sentencing concern the same significant events giving rise to these two news stories.

## TRAGEDY

**Helen Gavaghan. Bradford, UK. 30th January, 2017:** Of five brothers standing trial for murder at Bradford Crown Court in the UK two were this afternoon found guilty. The murdered man was their cousin, Mr Sarfraz Khan (35), who died shortly before midnight on 14th April, 2016 after being stabbed in the heart. Those found guilty of his murder are Mohammed Ali Nasar (33) and his younger brother, Tariq Mahmood (26), both of 20 Cecil Avenue in Bradford, West Yorkshire, UK. The Court heard that the murder weapon was not found.

M. Ali Nasar was additionally found guilty of wounding with intent to cause grievous bodily harm three of his other cousins, namely Mohammed Idris Khan, Aftab Khan and Mohammed Asad Khan. Tariq Mahmood was found guilty of GBH of Aftab Khan and Mohammed Asad Khan. Only M. Nasar Ali had faced charges of wounding Mohammed Idris Khan.

Tariq Mahmood told the jury he had stabbed Aftab Khan in defence of his sister, Zayneb.

Both men had entered not guilty pleas to all charges, and maintained their plea under cross examination on the stand earlier this month.

Of the remaining three brothers standing trial for murder and other charges the jury found Sajid Hussain (33) not guilty of all counts on the indictment. Two brothers, Amir Ali (20) and Amjid Ali (39), were found guilty of manslaughter of Sarfraz Khan, but not guilty of murder. The jury returned not guilty verdicts of Amjid Ali and Amir Ali committing GBH against their cousins Aftab and Mohammed Asad Khan, but concluded they had wounded under a section of Statute of lesser seriousness.

The prosecution had argued common intent by all five brothers in all cases other than the wounding of Mohammed Idris Khan, of which only M Ali Nasar was accused. Such common intent can be formed in a moment, the judge told the jury.

Sentencing will be on Friday, and arguments may include issues relating to secondary involvement.

The Honourable Mrs Justice Cheema-Grubb QC discharged Mr Sajid Hussain, telling him he might leave the dock. She then remanded his brothers into custody.

The prosecution succeeded in obtaining its guilty verdicts despite a significant amount of evidence, such as the blood-stained T-shirt of M Ali Nasar, not having been tested.

In reaching their verdict the jury had access to witness statements presented in Court, to witnesses cross examined in Court, extensive CCTV footage, and schedules of telephone calls. Each defendant had a QC and junior as advocates. Mr Alistair MacDonald QC and Mr Nicholas De La Poer prosecuted on behalf of the Crown.

Continued on page 29 ... 28

When addressing the jury the judge outlined limitations of some of the types of evidence called on by the prosecution to support its case. She emphasized it was the jury's duty to decide the significance of the evidence, drew their attention to pitfalls such as confirmation bias, and she provided logical routes to reaching the 17 possible verdicts they had to consider.

Before the jury returned their verdicts the judge warned all in the Court that the jury must be heard in silence.

After a faltering start to the trial the jury in the case began hearing evidence on 17th November, 2016. They retired to consider verdicts last Wednesday morning. All the verdicts were unanimous.

Though I asked no questions other than how to spell the names of their father and uncle I had some conversation with Sajid Hussain and Amir Ali during the three plus days the jury was deliberating. I said how difficult it must be to stand where they were standing, and Sajid Hussain said, "Especially when you are innocent." His brother, Amir Ali, asked me what I thought, and I replied it was sad. He said, "Yes, it is very sad." **HG**

## SENTENCING

"Nothing I do will propitiate the grief of this family," said Mrs Justice Cheema-Grubb QC, before sentencing two brothers for the murder of their cousin, Mr Sarfraz Khan (35), of Cecil Avenue, Bradford in West Yorkshire on 14th April last year."

Her ladyship handed down terms for Mr Mohammed Ali Nasar (33) and his brother Mr Tariq Mahmood (26), also of Cecil Avenue, for a totality of, respectively, 30 years and 71 days and 27 years and 71 days. These are the minimum period each must serve before either man can be considered for release. They encompass mandatory life sentences. The terms are for all offences of which each was found guilty. Mohammed Nasar was convicted also of the grievous bodily harm of three of his cousins - Idris, Aftab and Asad Khan. Mr Tariq Mahmood was convicted, in addition to murder of Mr Sarfraz Khan, of GBH of Aftab and Asad Khan.

Totality is a legal concept, explained by the judge in the context of sentencing council guidelines, legal rulings and her findings of the meaning of the jury's verdict. Defence counsel had each previously presented their interpretations of the law in defence of their clients and in response to documents the prosecution had already circulated to them.

Two other brothers - Amjid Ali (39) and Amir Ali (20), who also lived close to the murdered man, and who are brothers of Mohammed Nasar and Tariq Mahmood - were sentenced for the manslaughter of Sarfraz Khan and for wounding their cousins Aftab and Asad Khan. The combined sentences Mr Amjid Ali received adds up to a total of 22 and a half years, but he will serve a slighter lesser amount of that time in prison, and be eligible to apply for release within half of the sentence time in custody. Amir Ali's total sentence adds up to 17 years, again with a slightly lesser time as the period in custody, and again he will be eligible to apply for release after half of the time served inside prison.

Continued on page 30... **29**

The murder weapon was not recovered, and the judge said she was sure it was removed from the scene. She also could not be sure who struck the fatal knife blow. The jury's guilty convictions reflect that the prosecution had succeeded in its case that there was a plan and joint intent. As she explained her sentencing the judge clarified which defence arguments she rejected.

After sending down the convicted men her ladyship went on to thank the family and extended family of brothers and cousin's for their dignity during the nine week case.

And now at last the reality spilled from the families in words and controlled anger, in emotion and in words shouted in pain for the Court to hear.

The judge commended Detective Chief Inspector Swift, Detective Sergeant Marcus Dawson, DC Price and family liaison officers in the case. **HG**

**I began following the trial on 6th January, 2017, just as the prosecution was closing its case, and the defence opened theirs. ||**

### **Litigants in person, and other matters, views from the retiring Lord Chief Justice of England and Wales**

Litigants in person are a problem across the whole judicial system of England and Wales, said Lord Thomas, the Lord Chief Justice of England and Wales, during a press conference on 30th November, 2016. Legal aid cuts for family disputes exacerbate the problem in Family Courts, he told reporters, and litigants in person take up too much time in the Appeal Court.

**See press conference transcript:**

<https://www.judiciary.gov.uk/wp-content/uploads/2016/11/lcj-annual-press-conference-2016-transcript-1.pdf>

Nevertheless, Lord Thomas does not think that payment to non-lawyers is the answer. He expressed concern in the context of crime and immigration, two fields in which people are particularly vulnerable, and where poor law has severe consequences. Lord Thomas said there is too much risk of non-lawyers giving advice someone wants rather than needs to hear.

Other questions taken by Lord Thomas addressed the need for realistically tough alternates to custody, if an offender's crime is on the cusp of having passed the custody threshold. He was neutral on the topic of whether an offender carrying out a community sentence should wear distinct clothing. It is not part of British tradition, he said, but told reporters there was a debate to be had on the subject. He also thought it unacceptable if a community sentence led to an offender thinking he/ she had "got away" with it.

At the beginning of November, Lord Thomas, who leaves office in 2017 under current rules governing the retirement age of judges, had released his annual report. The primacy of common law and stature of the judiciary should be maintained, he wrote, and the constitutional role of the judiciary be better understood. In [2017] UKSC-1, reported on p27 of this section, the constitutional relationship of judiciary and executive in the context of a Crown act of state is touched on.

Lord Thomas also write diversity needs to be strengthened, and a proper balance struck between private fees and State funding. **HG ||**

## THE VIEW FROM BEACON HILL

Brave blue light hurrying through Halifax,  
 At this distance silent, seeming slow, slicing the town in two.  
 Behind you the hospital: ahead a life hanging by a thread  
 Unable to see what I see  
 As the 571 makes its way down Beacon Hill.  
 We meet at the base. Bus giving way to ambulance.  
 The siren's Doppler beat reaches crescendo,  
 And fades as the blue light climbs steadily  
 To reach its unknown destination.

By Helen Gavaghan, 4th January, 2017. Edited by HG 7th January, 2017.

Published online first on gavaghancommunications.com, and removed from that website on 23rd February, 2017.

**Test your knowledge of events significant to scientists and politicians internationally  
 between 26th November, 2016 and 23rd February, 2017.**

Answers on page 4 of this issue. Devised by the editor.

### TODAY 24th FEBRUARY 2017

1. On what date was Donald Trump elected president of the United States of America?
2. On what date was Donald Trump sworn in as 45th President of the United States of America?
3. What is the name of the Secretary General of the United Nations who assumed office on 1st January, 2017?
4. Who was President of the Royal Society of London on 1st January 2017.
5. Which Nobel peace laureate delivered his Nobel lecture on 10th December 2016?
6. Name 3 non-EU, European Organisations undertaking science research.
7. On what date did the Outer Space Treaty come into effect?
8. What does the acronym ISRO stand for?
9. Who was director general of the World Health Organisation on 1st January 2017?
10. Who was President of the European Commission on 1st January, 2017?

ADVERT

WE ARE

ENABLING

PROVOCATIVE

INFORMED

ENGAGING