

David MacKay

Born 22.4.1967

Life story compiled by Alex Reid.

Available online at www.livesretold.co.uk

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1. Introduction



David MacKay on 3rd April 2016.

This short account has been compiled from internet sources as a tribute to Sir David MacKay – physicist, mathematician, inspiring teacher and vigorous campaigner for action on climate change. MacKay spent his academic career at Cambridge University, during which time he published profusely and wrote two books: *Information Theory, Inference, and Learning Algorithms* (2003) and *Sustainable Energy – Without the Hot Air* (2008).

He was Chief Scientific Adviser to the UK Department of Energy and Climate Change from 2009 to 2014. In 2011 he was appointed as the first holder of the newly created Regius Professorship of Engineering at the University of Cambridge.

He was diagnosed with stomach cancer in July 2015, and died at Addenbrooke's Hospital Cambridge, aged 48, on 14th April 2016.

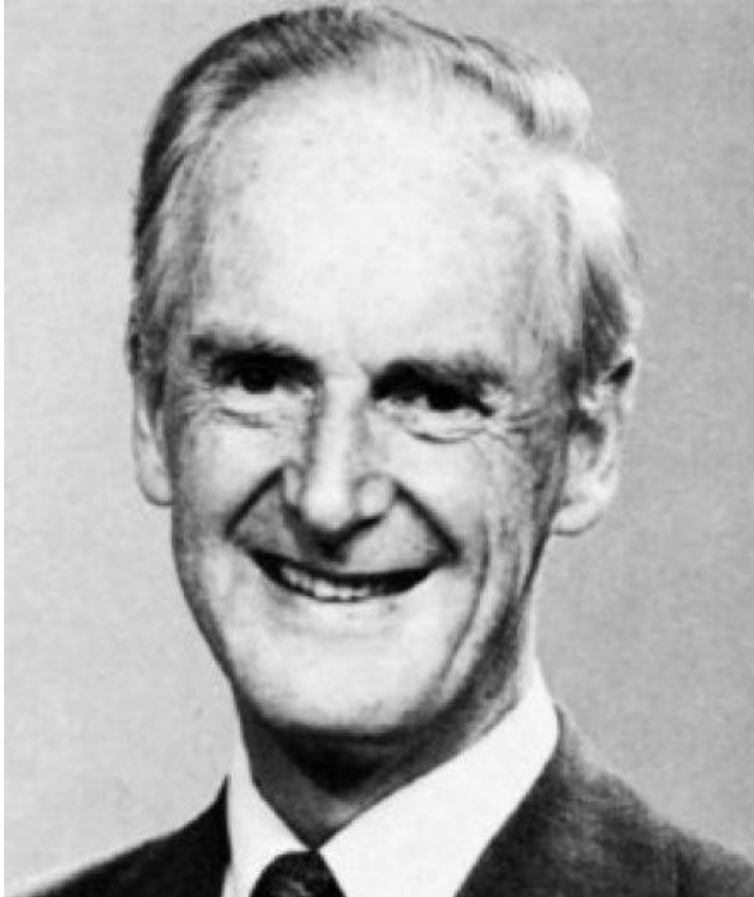
2. Parents

David John Cameron MacKay was born on 22nd April 1967, the fifth child of Donald MacCrimmon MacKay and Valerie MacKay. His father was a physicist and professor at the Department of Communication and Neuroscience at Keele University, known for his contributions to information theory and to the theory of brain organisation.

He was educated at Wick High School, St. Andrews University, and King's College London

David MacKay's mother Valerie – initially one of Donald's students – later completed her doctorate and taught physics at secondary school level. David's brother, Robert, now a professor of mathematics at the University of Warwick,

remembers their mother demonstrating the orbital relationships of the sun and earth by putting a knitting needle through an orange and moving it around a lamp. David's sister Janet Lefroy is a GP and lecturer in medicine at Keele University, while his other sisters, Margaret and Eleanor, made successful careers in Christian publishing and speech therapy respectively.



David MacKay's father Donald.

3. Childhood & Education

David MacKay attended Newcastle High School. At the age of 18 he represented the UK in the International Physics Olympiad in Yugoslavia, and won the first prize for experimental work.

He continued his education at Trinity College Cambridge, obtaining his degree in Natural Sciences in 198. He attended the California Institute of Technology as a Fulbright Scholar, and obtained his PhD in 1992.

4. Academic Career

In 1992 MacKay was appointed to a research fellowship at Darwin College Cambridge, and in 1995 he was appointed as a university lecturer in physics at the

Cavendish Laboratory. He was promoted to a readership in 2003, and to a professorship in 2003.

MacKay's contributions in machine learning and information theory include the development of Bayesian methods for neural networks the rediscovery (with Radford M. Neal) of low-density parity-check codes, and the invention of *Dasher*, a software application for communication especially popular with those who cannot use a traditional keyboard. He cofounded the knowledge management company Transversal. In 2003, his book *Information Theory, Inference, and Learning Algorithms* was published.

His interests beyond research included the development of effective teaching methods and African development; he taught regularly at the African Institute for Mathematical Sciences in Cape Town from its foundation in 2003 to 2006.

5. Royal Society

MacKay was elected a fellow of the Royal Society in 2009. His certificate of election reads:

David MacKay introduced more efficient types of error-correcting code that are now used in satellite communications, digital broadcasting and magnetic recording. He advanced the field of Machine Learning by providing a sound Bayesian foundation for artificial neural networks. Using this foundation, he significantly improved their performance, allowing them to be used for designing new types of steel that are now used in power stations. He used his expertise in information theory to design a widely used interface called "dasher" that allows disabled people to write efficiently using a single finger or head-mounted pointer.

6. Regius Professorship of Engineering

In 2013 he was appointed to the newly created post of Regius Professorship of Engineering. Regius professorships are the most senior academic posts at the University of Cambridge. Prior to the creation of the Regius professorship in engineering in 2011 the last Regius professorships (in Botany and History) had been created in 1724. The other five Regius professorships, in Civil Law, Divinity, Greek, Hebrew, and Physic, had been created in 1540.

The following is extracted from the University of Cambridge press release announcing MacKay's appointment as Regius Professor:

*An eminent researcher in machine learning and information theory, and a Fellow of the Royal Society, Professor MacKay is perhaps better known to the public for his ground-breaking work on sustainable energy and, in particular, as the author of the critically acclaimed book, *Sustainable Energy – without the hot air*. Since 2009, he has also been Chief Scientific Advisor to the UK Government's Department of Energy and Climate Change.*

Regius Professorships are Royal academic titles, created by the monarch. The Engineering role is a new Regius Professorship, announced in 2011 to celebrate the Duke of Edinburgh's 34 years as Chancellor of the University.

The new post is designed to give an outstanding academic the opportunity to build on the Department of Engineering's world-leading research in fields that address major, global challenges. These include: creating lasting energy solutions, building cities in the future, managing risks and driving innovation.

Professor MacKay's work with the Engineering Department will focus, in part, on the study of how we can model and communicate the full economic and societal impact of a shift to sustainable energy sources – a continuation of his recent work with the Government. He will also collaborate with academics, both within Engineering and elsewhere at Cambridge, to explore new opportunities in energy efficiency, renewable energy, and energy storage.

"I am hugely excited about this opportunity," Professor MacKay said. "Everything I have done over the past two decades has had an engineering element to it, and since developing an interest in sustainable energy that has only increased."

"The wonderful thing about this role is that I will have the chance to work alongside some truly fantastic engineers. My hope is that I will be able to bring new ideas about energy research to a Department which is already full of talent that can develop prototypes and bring those concepts to life."

As Regius Professor of Engineering, MacKay will continue work he has already begun with the Government on "whole energy system modeling" – examining the full implications of a shift away from fossil fuels towards secure, low-carbon energy supplies. His current work, notable with the open-source "2050 Calculator", describes how behavioural or technological changes in fields such as transport, lighting, heating, energy storage, and land and livestock management will impact on the scale of energy demand, energy supply, and greenhouse gas emissions.

"Modeling tools like this have a huge impact on the public understanding of energy options, as well as policy-making itself," he said. "The more explicit and transparent we can be about the trade-offs involved in a shift away from fossil fuels, the better our final decisions will be. It helps to engage the public with the options, and replaces a culture of negativity by allowing people to understand what a low-carbon future will entail in a more complete and positive way."

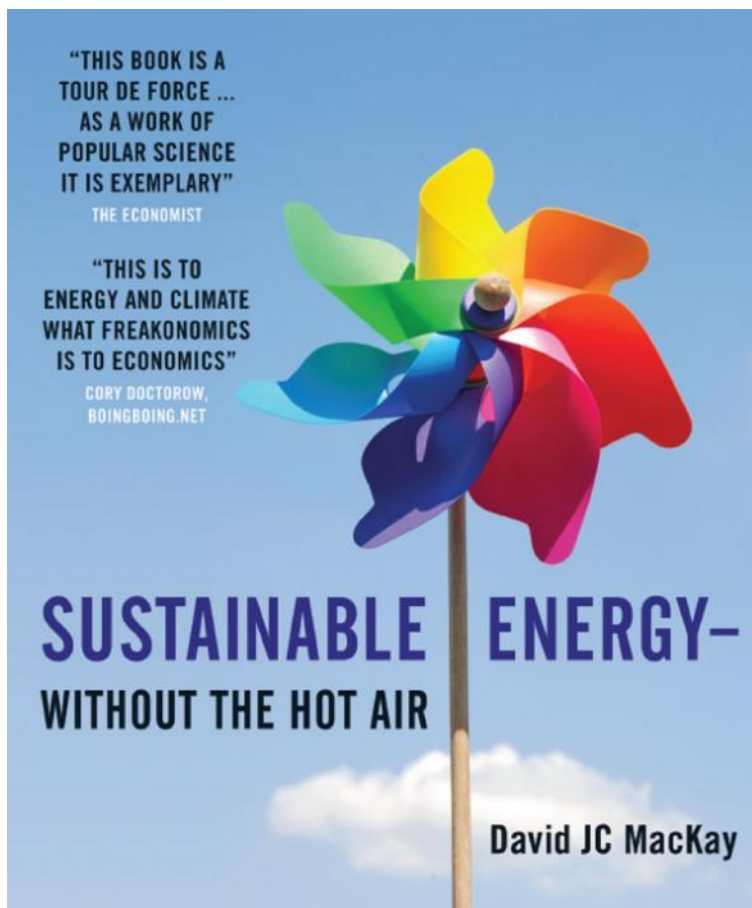
MacKay's work at Engineering will also allow him to explore other, "blue skies" ideas on similar themes. In particular, he is interested in developing a cross-Cambridge collaboration, involving several departments around the University, which will look at developing biosystems that can efficiently turn sunlight into electricity and useful chemicals. Other possible projects may examine "osmotic power" (the extraction of energy from river mouths, where fresh water meets sea water), "kite power" (a possible solution to providing wind power without turbines), and new energy storage solutions.

Professor MacKay will take up his role as Regius Professor on March 29. He will continue in his role as Chief Scientific Adviser to the UK Government's Department of Energy and Climate Change, which is due to run until the autumn of 2014.

David MacKay received a knighthood in 2016.

7. Sustainable Energy Without the Hot Air

In 2008 MacKay completed a book on energy consumption and energy production without fossil fuels called *Sustainable Energy – Without the Hot Air*. MacKay used £10,000 of his own money to publish the book, and the initial print run of 5,000 sold within days. The book received praise from *The Economist*, *The Guardian*, and Bill Gates, who called it "one of the best books on energy that has been written." Like his textbook on Information theory, MacKay made the book available for free online. In March 2012 he gave a TED talk on renewable energy, drawing on the content of his book.



The book has received glowing reviews from readers. For example Rachel de Coverley wrote in October 2014:

I cannot praise this book highly enough. With admirable clarity, honesty and lack of bias, David MacKay sets out the facts surrounding energy consumption and renewable energy generation. He explains, with the help of clear and not overly complicated mathematics, how much energy our different activities consume. He also explains, in a similar way, the capacity of different sustainable and non-carbon

energy sources to meet that consumption. He enables the reader to understand the facts and make comparisons and informed moral choices.

The result is quite sobering reading. For example, after reading and understanding this book you will realise that at present rates of individual consumption (flying abroad, driving around a lot, buying lots of consumer goods and turning up the thermostat) there is no way we can meet our energy needs from renewables without also including nuclear power in the mix and/or completely industrialising our landscape (assuming we want to stop using fossil fuels). However MacKay is NOT a doom-and-gloom merchant. The facts speak for themselves. While 'climate change denial' is not logically justifiable after reading this book, MacKay's view is: okay we've got a problem, so let's look at the facts and see what can be done. But let's not obfuscate and cover it up with platitudes like "we've got a huge amount of wind in Britain" - as he shows, 'huge' is relative, and it turns out that our consumption is a whole lot huger.

The book is beautifully designed and illustrated with clear diagrams expressing all the information you need to understand this topic; all of it useful, and some of it alarming and/or surprising. It should be compulsory reading for students of Year 11 upwards, and should be tax deductible for the rest of us! Having said that, it is also in the public domain so you don't have to buy the book; you can find it online and download the PDF.

8. Family Life



In 2011 David MacKay married Dr. Ramesh Ghiassi. She specialises in research into sleep disorders at Imperial College London. Their two children, Torrin and Eriska, shown above, were aged 4 and 1 at the time of David's death.

9. Illness and Death

David MacKay chronicled his illness from stomach cancer in his blog 'Everything is Connected'. He coped with his illness in an extraordinarily brave and moving way. The last post on his blog reads:

Perhaps my last post – we'll see

I noticed that the posts of a friend who died of cancer trickled away to a non-conclusion, and this seems an inevitable difficulty, that the final post won't ever get writ.

I'd like my posts to have an ending, so I'm going to make this my final one - maybe. While the doctors haven't expressed an opinion, I think it's possible I haven't got long to go, because I've lost 15 kg, and last Friday's CT scan showed that I've got secondaries on the go in my bones (as we already anticipated from the high ALP levels measured over the past weeks); my platelet count is very low, so they suspect that my bone marrow may be having trouble with cancer cells. On Monday they propose to take a bone marrow sample to find out what's going on. My extreme breathlessness continues - lying still in bed is fine, but getting out of bed onto the commode and back feels afterwards rather like a marathon. Maybe I'll pull through, but let's tentatively wrap up my blog-posts now.

There's lots I could write, but the way I'd like to stop is by pointing you to the writings of someone else. [Max Edwards](#) wrote a piece for the Guardian about his own cancer, and much of what he writes resonates for me. He was a remarkably eloquent writer. Thanks for reading!

10. Tributes

Guardian

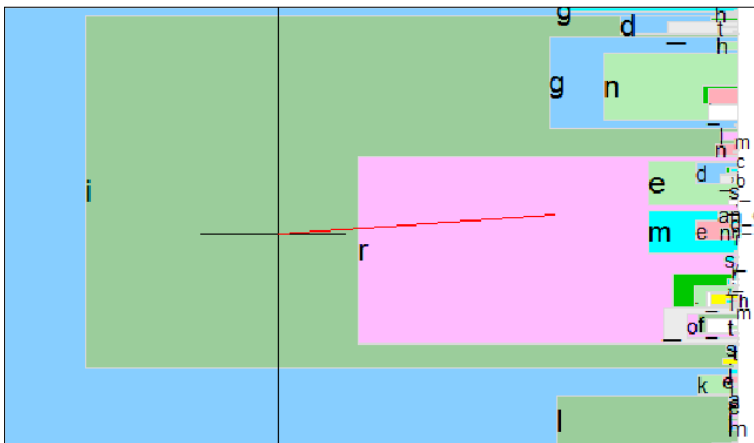


The following (and the image above) is extracted with acknowledgement from David MacKay's obituary by Mark Lynas in the Guardian:

Sir David MacKay, who has died of cancer aged 48, was a true polymath, a rare breed in today's world, where the frontiers of scientific knowledge are increasingly remote and complex. It is a testament to David's intellectual brilliance that he was able to contribute to advancing more than one of these frontiers during his short career.

*David latterly achieved cult status among climate and energy aficionados following the publication of *Sustainable Energy: Without the Hot Air* (2008), initially self-published using £10,000 of David's own money and offered – as were all his works – simultaneously free for download on his website.*

However, although less well-known outside academic circles, David's achievements in the fields of information theory, machine learning and neural networks were at least as important. Building on theories developed in the 1960s by Robert Gallager, David showed in 1995 that mathematical codes – technically termed low-density parity-check codes – could squeeze immense amounts of data reliably through noisy communication links. LDPC codes are now employed in varied applications such as computer disk drives, mobile phone networks, digital broadcasting and Wi-Fi, ubiquitous but essential components of our modern world.



Dasher screen keyboard presents areas based on the probability of the next letter.

David's interest in human-machine interfaces led to his 1999 invention of Dasher, a keyboard-free text-inputting program that uses a predictive language model to allow users to write efficiently using eye movements, head movements or even breathing. In appearance, Dasher resembles a video game: the user navigates Star Wars-style by zooming through an expanding galaxy of letters. Now available in over 100 languages, Dasher has been downloaded 140,000 times, and has transformed the lives of many people with impaired mobility. One Dasher user with cerebral palsy has even used it to write his master's thesis.

Born in Stoke-on-Trent, Staffordshire, David was brought up in a somewhat austere but intellectually vibrant household: his father, Donald, a committed Christian, was a physical scientist of wide renown, while his mother, Valerie (nee Wood) – initially one of Donald's students – later completed her doctorate and taught physics at secondary school level. David's brother, Robert, now a professor of mathematics at the University of Warwick, remembers their mother demonstrating the orbital

relationships of the sun and earth by putting a knitting needle through an orange and moving it around a lamp. David's sister Janet Lefroy is a GP and lecturer in medicine at Keele University, while his other sisters, Margaret and Eleanor, made successful careers in Christian publishing and speech therapy respectively.

Although an atheist by the time he graduated, David was perhaps influenced by his upbringing into remaining a lifelong ascetic, refusing to own a car for most of his life and insisting on turning down the household thermostats of whomever he happened to be visiting (myself included). He was an avid ultimate frisbee player until forced to give up by long hours at DECC and his later illness, diagnosed as incurable stomach cancer in 2015.

As a mathematician, David's expertise on Bayesian probability theory led to his dramatic intervention to help right a notorious miscarriage of justice, when the solicitor Sally Clark was wrongly imprisoned in 1999 after being accused of murdering her two babies.

David was horrified that a key witness for the prosecution had misused statistics to tell the court that there was only a 1 in 73m chance that Clark's babies had died naturally in cot deaths. He recalculated the probability and proved that Clark was far more likely to be innocent than guilty. David got involved in the campaign for her release, which was achieved after a second appeal in January 2003.

*His commitment to mathematical accuracy was combined with a refusal to give easy answers. "I don't want to feed you my own conclusions," he wrote in the first pages of *Without the Hot Air* (an early draft of which was tellingly called *You Figure It Out!*) "Convictions are stronger if they are self-generated, rather than taught." This continued the style of his earlier academic work. "You can understand a subject only by creating it for yourself," says the introduction to his landmark textbook *Information Theory, Inference and Learning Algorithms* (2003).*

David's numerate and disarmingly honest approach to the energy issue brought him lasting respect from all sides of what had become an increasingly rancorous debate. Perhaps his most famous line is buried on page 169: "Please don't get me wrong: I'm not trying to be pro-nuclear. I'm just pro-arithmetic." Rather than confounding the reader with terawatts, gigatonnes and suchlike, he insisted on using standard units – the kilowatt-hour (roughly one 40-watt lightbulb left on for a day) – to compare the energy realities of everything from solar power to air travel to vegetarianism. "We need numbers, not adjectives," he wrote.

This unusually rational approach caught the eye of the government, and David was appointed chief scientific adviser to the Department of Energy and Climate Change in 2009, reluctantly swapping his customary academic garb of shorts and sandals for a suit and tie during his subsequent five years at DECC.

Pragmatic enough to recognise the constraints that being a government adviser implied – not least on his freedom of speech – David made a surprisingly effective civil servant, convincing the then coalition government to publish a carbon plan in December 2011 that drew directly on his numerate approach towards energy.

Financial Times

Nick Butler wrote in the Financial Times of April 19th 2016:

The saddest news of the last few days has been the death of David MacKay, an eminent Cambridge scientist who succeeded in communicating the complex issues of energy policy to a non-specialist audience with enormous clarity. David embodied Cambridge at its very best, combining insatiable intellectual curiosity, intolerance of sloppy thinking and received wisdom, and a sharp desire to apply knowledge to improve the world as a whole.

Having read Natural Sciences at Trinity, David began his career with a PhD from Caltech on neural science. He developed a way to correct signal interference, which is now used in digital broadcasting and magnetic storage of information, such as on computer hard drives. He also advanced the field of machine learning by improving artificial neural networks and invented a software application that enables communication in any language with any muscle of the body.

In scientific terms he was a polymath. But he will be remembered most of all for his work on energy – the subject of most of his work over the last decade. In 2009 he published on the web a book called Sustainable Energy – without the hot air. To his surprise the text was downloaded over 400,000 times. To his even greater surprise a printed version sold 40,000 copies – an amazing number for a work of non-fiction running to several hundred pages. If you have not read it, you should – it is still available for free in a dozen different languages on this website. The arguments are practical and accessible. You do not need a PhD to read it and you will not be bored. Mr MacKay was a distinguished academic – first Professor of Natural Philosophy and then from 2013 Regius Professor of Engineering, but always found time to catch the train to London to engage in the debate on policy.

From 2009 to 2014, he was the Chief Scientific Adviser at the Department of Energy and Climate Change. He argued on the basis of facts and numbers and much disliked the woolly faith base thinking which can so easily distort rational policy outcomes. His advice was not always accepted. Subsidies to the producers of biomass products such as the woodchips imported to fuel power stations continued to rise, despite his detailed analysis which showed that in many cases the way in which such products were produced and transported only served to increase the burden of carbon emissions they were supposed to be relieving. The power of the entrenched lobbies which are so influential in shaping energy policy in the UK and elsewhere was too strong.

One can only regret that he never had the chance to work with a Secretary of State with the ability to engage with his arguments. He had much more to do – in the academic world and in applying his knowledge to the making of public policy but illness intervened and his death at the age of only 48 is a great loss.

The work goes on. Mr McKay helped to set an example and energy is now a prime topic of research in science and engineering in the Cavendish Laboratory in Cambridge and in many other universities. So is the debate on how to use public

policy to encourage and apply the technical advances which are necessary. Energy policy and the science behind it are not so complicated that they has to be left to specialists. They are matters everyone should understand. A continuation of the broad open fact based debate on energy and its challenges which he helped to foster is the best tribute we can give to a remarkable man.

Trinity College Annual Record

The 2016 edition of the Trinity College Annual Record contained the following:

David MacKay was a founder of the modern approach to information theory: he pioneered the combination of Bayesian inference with artificial neural network algorithms to allow rational decision making by computer, and made key improvements to communication protocols such as error-correcting codes. His research led to a masterly book, “Information Theory, Inference, and Learning Algorithms” (2003), and underpins much of the current research area known as ‘deep learning’.

MacKay was a man of high principles: an uncompromising seeker of truth who believed in the power of rational, quantitative thought in all aspects of life. He was also a highly entertaining, enthusiastic and committed teacher. All these qualities are displayed in his second book, “Sustainable Energy: Without the Hot Air” (2008), which first quantifies the vast challenge posed by the need to overcome humanity’s addiction to fossil fuels, and then enables the reader to think clearly about how to address that challenge, through behavioural change by nations and by individuals.

MacKay emphasised that small changes are not enough: his own lifestyle choices included vegetarianism, minimizing travel by car and plane, and parsimony in domestic heating. These choices echoed an ascetic upbringing whose religious basis he nonetheless rejected in adulthood.

Bill Gates

Microsoft founder Bill Gates wrote on his GatesNotes blog:

I was sad to learn last month that David MacKay had died of cancer. He was just 48 years old. David was well known among those who study clean energy, and he had a big influence on a lot of people, including me.

I discovered David through his eye-opening book Sustainable Energy—Without the Hot Air. He was a physicist at Cambridge University, and his goal was to, as he put it, cut “UK emissions of twaddle” by helping people think more rigorously and numerically about clean energy. His book doesn’t favor one zero-carbon solution over another. He just shows you how to do the math for yourself, so you can work out the answers to big questions like “how much carbon do cars emit?” and “how much energy can we expect to get from renewable sources?”

Sustainable Energy really shaped my thinking. A few years ago, when I gave a TED talk on energy, I bought 2,000 copies to pass out to everyone in the audience. To

this day, if you want to understand the opportunities for clean energy, nothing else comes close. I still go back and re-read parts of it myself.

Revisiting his work will be a bittersweet experience now. I had the pleasure of getting to know David and learning from him. He was always generous with his time, and he was just as thoughtful and unassuming in person as he was in writing.

Mark Lynas

In addition to his more formal obituary in the Guardian, science writer Mark Lynas has published on his website a personal and moving tribute to David Mackay, from which the following is extracted:

The end, when it inevitably came, arrived much sooner than any of us – even David – had expected. After his diagnosis with terminal stomach cancer in July 2015, David MacKay, with characteristic mathematical clarity, sketched out his likely life expectancy on a whiteboard graph. He gave himself a 50:50 chance of surviving until January 2017, while “>2 years” was “v. unlikely”.

*Probabilistic thinking came easily to David, as the many aficionados of his landmark textbook *Information Theory, Inference and Learning Algorithms* who are currently deluging Twitter with moving and heartfelt condolence messages will attest. However, sadly for David, for his family, for all of us, and indeed for the world, his remaining lifetime was very much at the left side of the S curve, and he died on the afternoon of 14 April 2016, just a week short of what would have been his 49th birthday.*

David’s early death is desperately sad. David was not sentimental, but I simply can’t think of any other word. His children are so young – Torrin is 4 and Eriska only 1 – and now their father will not get to see them grow up, and his wonderful wife Ramesh is left alone. It seems so bitterly unfair. David wrote about all of this in his sparkingly honest and witty blog ‘Everything is Connected’, and his post ‘What do you tell the children?’, written on 13 September last year, dealt unsparingly – and humourously – with that uniquely awful dilemma. He knew he was running out of time by early April, and posted a farewell message of sorts: ‘Perhaps my last post – we’ll see’, with this opening:

I noticed that the posts of a friend who died of cancer trickled away to a non-conclusion, and this seems an inevitable difficulty, that the final post won’t ever get writ. I’d like my posts to have an ending, so I’m going to make this my final one – maybe. While the doctors haven’t expressed an opinion, I think it’s possible I haven’t got long to go...

It wasn’t quite the last one, but subsequent posts – including a poignant but hilarious one about the hospital’s lack of “intelligent thermal environmental control” (which I really hope Addenbrookes and other hospital authorities will read and act on) are labelled Appendices “to my completed cancer story”. In the end, David got it just right, with his final Appendix 3 blogpost being a JustGiving site to raise money – in his memory, it now turns out – for the Arthur Rank Hospice Charity (please do donate – it is incredible how his fundraising target has already

been quickly surpassed). I got a final text from him, just a day before he died, saying with characteristic straightforwardness “no visit thanks”.

David MacKay had more personal and professional integrity than anyone I have ever known – and yet somehow he managed to combine it with a warmth that underlay everything he did. (I was privileged to attend his celebratory Symposium in Cambridge just a month ago – I don’t think I have ever been in a scientific meeting with so much love in the room.) He wore his super-intelligence – people use the word ‘genius’ rarely these days, but I’ve heard it used for David a number of times – lightly, and always interacted with humility and an enduring sense of fun.

David had a strong moral compass and sense of justice – his work was fundamentally driven by a desire to make a difference, and to help solve real problems, even intractably huge problems like climate change. His massive contribution was bring numeracy to a debate obscured by mudslinging and ideologically-motivated rhetoric (both of which I’m as guilty of as anyone).

*It was characteristic of this desire to see real change that he accepted the immense challenge of taking on the role of Chief Scientific Advisor at the UK government’s Department of Energy and Climate Change, rather than staying in the ‘ivory tower’ of Cambridge, after the enormous success of his epochal book *Sustainable Energy*, without the hot air. As you’ll see from the above lecture (perhaps my favourite, given in Oxford in 2014) David was most of all a quite simply brilliant teacher. It was not just that he was a gifted communicator – perhaps a rare thing for an expert on information theory and machine learning – but that he understood the need to help other people understand.*

This could take a lot of his time, which he always gave generously: on one occasion, on a Skype call, he spent an hour sketching graphs on a handy piece of cardboard in a doomed effort to impress on me the basics of Bayesian statistics (we were talking about p values being misused in scientific papers to inappropriately infer statistical significance). I still don’t understand Bayesian inference, but I trusted David to be right on that and a lot else besides more than I’ve ever trusted anyone before or will again.

That’s the problem with wise teachers like David MacKay. Normal people like me just want to be given the answer by someone super-smart that we trust, and thereby be told what to think. But David wouldn’t be drawn into handing out easy answers, whether as a university professor, a writer, a speaker or a government advisor. His whole effort was focused on giving people the tools and understanding so they could figure out the answers for themselves – even government ministers.

And that is his legacy. Though the world has lost an incredible brain, and is the poorer for it, David left us everything we need to figure out for ourselves how to proceed with solving climate change – and other problems, however huge and complex they may appear. His formula is disarmingly simple: we have to get the numbers right, and think things through rationally from first principles. To borrow David’s best-known quote, we don’t have to be anti-this or pro-that: we just have to be “pro-arithmetic” and the rest will follow. I hope that we can do this, both to

cherish David's memory and because such an approach is after all the only way to get to the right answer.



Left to right: Maria Padget, Mark Lynas, David MacKay, Tom Lynas, Torrin MacKay, Rosa Lynas, Ramesh Ghiassi, Eriska MacKay – September 2015, taken by David on an automatic setting after several unsuccessful attempts!

Last Word

Among many online personal tributes to David Mackay, Peter Grossenbacher wrote this at the website of Varsity, the Cambridge University student newspaper:

What a great human being for us to lose so soon. Good thing he made the most of his life on so many fronts! Despite all his talents and accomplishments, his down to earth nature kept him tuned to the channel of our shared humanity. I will miss him dearly.
