. . . mathematical models to be built on actuarial life tables . . .

policy tends to lead to incremental research rather than real innovation, which is inherently unpredictable.

- The openness and non-hierarchical structure of British culture allows new ideas to gain a foothold, new talent to find a ready audience.
- Diversity (of scale of organisation, of mode of research – solo/team, interdisciplinary/narrow, applications-focused/blue skies) is key.

All the above features of UK mathematical science have been massively aided by the dual support system for funding research, allowing new ideas to start with small first steps, new talent to develop from a wide base (it is worth remarking that the Cambridge mathematician and Fields Medallist Sir Tim Gowers has never held a research council grant).

The key message from the last 60 years is that most progress has been through glorious surprises. No one except a few crazy science fiction writers could have predicted the way computers would come to pervade our lives, nor the way that new mathematics would be needed to facilitate this. Modern statistical methods allow information to be extracted from data in previously unimagined ways. The deep interconnections between different areas of mathematics, and between mathematics and the sciences, that have emerged are similarly mysterious and could not have been foreseen in 1952.This does not mean that all future developments are unpredictable – it is clear that the mathematisation of the biological sciences will continue apace and holds some exciting prospects, and understanding climate change provides a challenge – but it does make it likely that the next real innovations will, by definition, be surprises.

The UK has been at the forefront of change over the past 60 years, and we need to ensure it remains at the cutting edge of progress for the next 60 years. Not just for the intellectual excitement of discovery, but also for its societal impact. How will the next 60 years go? All we can say is: watch this space!

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Footnotes

1 Figures from Thomson Reuters at http://www.timeshighereducation.co.uk/story.asp?sectioncode=26&storycode=406463 Denmark were first, the USA third.

2 J. H. Wilkinson, *Rounding Errors in Algebraic Processes*. Englewood Cliffs, New Jersey: Prentice Hall, 1963.

3 D.R. Cox, Regression models and life tables, *J Royal Statistical Society B* 34 (1972), 187-220.

4 A.E. Gelfand and A.F.M. Smith, Sampling-based approaches to calculating marginal densities, *J. American Statistical Association* 85 (1990),398-409.

5 A. Turing, On computable numbers, with an application to the Entscheidungsproblem, *Proc. London Math. Soc.*

AN UNSCIENTIFIC CAMPAIGN

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Science has not traditionally taken centre field in US political campaigns and it is unlikely that this campaign will be an exception. Issues around the economy, jobs, healthcare and taxation are likely to be the battle grounds of the next few weeks.

When science does enter the campaign, it will most likely be as a supporting player in the blue touch paper issues such as climate change, other environmental policy, or stem cells. For example, early in the campaign one of Governor Romney's most frequently broadcast advertisements highlighted his promise to restart construction on the Keystone XL Pipeline – the extension to the Keystone Pipeline which currently brings crude from the Athabascan fields in Alberta to Illinois. Keystone XL would add capacity and extend the pipeline to Texan Gulf Coast refineries. Whilst President Obama approved the Cushing, Oklahoma to the Gulf Coast portion of the Keystone XL, he has delayed, pending further environmental review, the section which would cross the Ogallala Aquifer in Nebraska, one of the largest reserves of fresh water in the world.

At writing, Governor Romney's team of advisors on science is structured in much the same way John McCain's was in 2008; that is, there is no central science advisor, but small teams focusing on issues such as space, energy, and health. These teams are often populated by names familiar from President Bush's Administration. Former NASA Administrator Mike Griffin advises on space; former Missouri Congressman Jim Talent serves on the energy team; and former Environmental Protection Agency Administrator and Health Human Services Secretary Mike Leavitt is advising

. . . no central science advisor . . .

Governor Romney on health issues. Mike Leavitt would also lead the Romney Presidency's transition team following the November election and has been mentioned as a possible White House Chief of Staff. In general, Governor Romney's team is more centralized than the President's. The President, of course, can draw upon the large number of presidentially appointed positions inside the Administration and the network that comes along with the Presidency.

Recently, both candidates answered 14 questions on various issues posted to sciencedebate.org. In these questions and in their other messaging, there are three particular science areas to watch for potential differences between the candidates. The first is space. Governor Romney's advisors favour a return to a manned space exploration strategy, whereas the Administration has shown a tendency to focus on robotic missions. With the termination of the Shuttle programme in 2010 and the cancellation of the Constellation programme – which was in effect a Shuttle replacement – the same year, NASA has moved almost exclusively to unmanned missions. If President Obama is re-elected, this will probably continue. Governor Romney may try to revive a launch programme, motivated in part at least by a desire to prevent the US from relying on Russian launch services. Whichever candidate is successful, they will have to develop a Space policy under tight fiscal constraints in 2013 and beyond. Uncertainty about the direction of the US Space programme will continue for some time.

The second area is energy policy. The popular phrase for both candidates this year is "all of the above" indicating support for all types of energy production. Both campaigns have used this term and both President Obama and Governor Romney support additional drilling for oil and natural gas and the increased use of nuclear power. However, as you dig into the detail areas of difference emerge. The Republican National Committee (RNC) worked hard over the summer to keep Solyndra, the bankrupt renewable energy company funded by the Administration's Department of Energy loan guarantee programme, in the news. And an RNC policy statement decries the Environmental Protection Agency regulations developed since 2009 as 'expansive regulations

. . . creating regulatory uncertainty . . .

that will impose tens of billions of dollars in new costs on American businesses and consumers. Many of these new rules are creating regulatory uncertainty, preventing new projects from going forward, discouraging new investment, and stifling job creation' concluding that 'the most powerful environmental policy is liberty.'

. . . key scientific posts remain fairly apolitical . . .

Thirdly there is life sciences. The major difference between the President and Governor Romney is in stem cell policy. Mitt Romney has consistently opposed embryonic stem cell research since before his tenure as Massachusetts governor. President Obama who famously said 'Medical miracles do not happen simply by accident' has been clear in his support for federal funding for embryonic stem cell research and this finally paid off in August this year when the US Circuit Court of Appeals upheld a lower court decision throwing out a lawsuit that challenged federal funding for the research. At present, it has not been raised so far in the 2012 campaign but both candidates will have their arguments ready to deploy.

As much a concern for the US science community as the outcome of the November elections is the possible time lag in nominating and confirming senior science officials in the Administration: a hiatus in leadership being seen as particularly unwelcome in times of budget uncertainly. In 2001, President George Bush waited eight months after his inauguration to appoint a Chief Science Advisor. In 2009, President Obama waited over four months to nominate a NASA Administrator. President Obama did name his science advisor and a NOAA Administrator before inauguration, viewed by many in the community as a step in the right direction. However, many key scientific posts remain fairly apolitical, even though they require Presidential nominations. Directors of the National Science Foundation, National Institutes of Health, and US Geological Survey are all appointed to six-year terms, and in most cases stay on even after a change in Administration.