Knocking on Heaven's Door/Lisa Randall and The Magic of Reality/Richard Dawkins

Saturday, September 17th, 2011 at 3:23 pm

My review for the Sunday Times before it was cut in half.

Knocking on Heaven's Door

How physics and scientific thinking illuminate the universe and the modern world

Lisa Randall

£20

Bodley Head

464pp

The Magic of Reality

How we know what's really true

Richard Dawkins

£20

Bantam Press

272pp

Four hundred years ago this year, the Catholic Church ruled that indirect observation of nature was an acceptable way of gathering evidence of how things are. This seemingly innocent judgment – coming in response to singular events of the year before – set science on

a course from which it has not wavered. In 1610 Galileo had constructed – out of a verbal description of a modish plaything seen in Holland – what we now call a telescope. Rather than pointing it across the street to spy on neighbours, Galileo swung his crudely made device up into the night sky and described what he saw there. In accepting that whatever fuzzy things he witnessed were evidence of something out there and not something conjured up by a couple of lenses set in an adjustable tube, the Church effectively defined and approved what we now think of as modern science.

Galileo was also one of the first scientists to use a microscope. Since his day, in their various technological re-imaginings, the telescope and microscope have extended our reach into the universe in both directions, to the largest and to the smallest regions of space.

In Knocking on Heaven's Door – an outstanding survey of the latest developments in physics and cosmology – Lisa Randall describes with dry wit and ice-cool clarity how the feed-back loop of model-building, theory, experiment and technology has written the history of scientific progress.

The telescope has become the space observatory, like the Planck satellite launched in 2009, sent out to look for the faintest evidence of radiation left over from the Big Bang, and which is not due to deliver its best data for several more years yet. The microscope has become the particle collider, most famously the Large Hadron Collider (LHC) at CERN, which again will not be operating at full power for some time to come, and produces so much data that it may take years before any definite claims can be made.

The LHC experiment is simple in outline. Two beams of protons moving in opposite directions are accelerated around a circular tunnel. Out of the combined energy of protons colliding head-on, it is hoped that exotic and previously unobserved particles will be brought into fleeting existence. In the strange world of particle physics, the tiniest constituents of the fabric of reality come into view only by injecting and concentrating large amounts of energy into tiny regions of space. Even more curiously, this process conjures up the conditions that existed close to the beginning of the universe. The LHC allows physicists to witness the universe as it would have been about a trillionth of a second after the Big Bang. (Bizarrely – and I'm running out of words of astonishment – the Planck satellite, seemingly looking in the opposite direction, further and further into the outer reaches of space, looks further and further back into time, and so it too is leading us back to the origins of the universe.)

It is easy to be overwhelmed by Big Science, but, as Randall points out, scientists don't usually set out to answer the Big Questions, they more likely become obsessed about some small question that they then worry at tenaciously, sometimes for years. Einstein didn't set out to re-describe gravity, he was trying to solve specific problems in the then new theory of electromagnetism. But his insights led first to his special theory of relativity, which in turn exposed the need for a new description of gravity. The general theory came after much effort 10 years later.

The irony of the LHC is that although it is enormous – 27 kilometres of tunnel 4 metres wide built deep underground housing 1232 magnets each 30 tonnes and 15 metres long, and though the beams of protons contained and accelerated by the magnets are hugely energetic – what is truly jaw-dropping is the fineness of the measurements being made. Individual proton collisions carry no more kinetic energy than two mosquitoes flying into each other, and even then most of the energy of the collision is carried forward with the rest of the beam as it makes its 11,000 circuits of the tunnel every second.

And every second there are a billion proton collisions to be recorded and then analysed. It was because CERN was generating vast amounts of data in earlier days that Tim Berners-Lee invented a way for scientists around the world to co-operate. This system of electronic co-operation became the world wide web. The superconducting magnets used in colliders led to the development of magnetic resonance machines now a feature of most major hospitals. It is too early to say what spin-offs the LHC might generate, but at $9 billion, or the cost of a pint of beer for every European citizen for each year of construction, it looks like good value for money.

Out of years of data, evidence from just a handful of collisions of the right sort may be all that is needed to point current theory in a completely new direction. The evidence will certainly be indirect. It will come as complex statistical patterns of energy from cascades of decay products decaying in turn into yet other particles. The history of physics is one of increasingly subtle and refined measurement of a reality that is captured by increasingly ingenious and indirect means. Fortunately, the game is likely to be never-ending. The universe is subtlest.

Randall, a professor at Harvard, has made and continues to make her own, often significant, contributions to the rarefied world of theoretical physics. Somehow, she has also found time to write a book that anyone at all interested in science must read, and which everyone ought to read. This is surely the science book of the year.

Richard Dawkins' latest book is a surprise. The man who is fast becoming the nation's irascible teddy bear has written a delightful book for children (that may tempt parents, too, after lights out). The Magic of Reality is a charming and free-ranging history of science. Go back through the family photo album and meet your 170,000,000 greats-grandmother, or learn how we come down with flu. Imaginatively chosen detail – did you know that there's an Alaskan frog that spends winter frozen into a block of ice? – keeps the narrative lively. I wish there had been such a book when I was a schoolboy. I would have devoured it, and pored over the beautiful illustrations. I would probably even have enjoyed Dawkins' re-telling of various ancient myths that he has collected from cultures around the globe and throughout history. As an adult these sections feel like mild propaganda. But that's OK; as a teenager I loved the Narnia books and they're propaganda too.