

YORKSHIRE PHYSICS NEWS

The newsletter of the Yorkshire Branch of the Institute of Physics

Spring 2007

50 years of computer technology

The press dubbed them “brain machines”. And when computers were delivered to six British universities 50 years ago, they heralded the dawn of a technological revolution.

Computing was very much in its infancy. Manchester University made the first, Cambridge built one too – but a huge government investment in 1957 kick-started academic computing, enabling state-of-the-art factory-built machines to be installed at Leeds, Southampton, Newcastle, Oxford, London and Glasgow.

It was a huge risk, as Prof. Roger Boyle, the current head of computing at the University of Leeds, explained: “They had no way of knowing if this was a good idea or not.”

The Leeds machine, Lucifer, cost £50 000 and was as far removed from the modern-day laptop as could be imagined. It was installed in a disused Methodist chapel on the edge of the campus, where a new concrete floor was laid to take its weight and minimise vibration. “It was enormous,” Boyle explained. “They had to winch many of the components through the roof.”

“There were no transistors – it was all valves and glowing lights – and came with armies of personnel who had to carry out a daily maintenance programme.” Sandy Douglas, who had worked on the Cambridge computer, was



Lucifer, the first computer at the University of Leeds, was at the leading edge of computer science and cost the university £50 000.



recruited to head up the team.

Programming was done by paper tape. “They would feed the tape into the machine, wait while it thought about it – often for hours – and then the answer would be spat out on more paper tape.”

And though by modern standards its memory was tiny and its processing speed slow, Lucifer enabled Leeds researchers to make complex calculations far more quickly than was possible using pencils, paper and slide rules. “It could do 12-figure multiplications in a fraction of a second,” said Boyle. “This made it a really valuable tool for physicists and mathematicians. Our machine was also used by chemists who needed its power for their work in crystallography.”

Their time on Lucifer was very precious. “If you were a user you had to understand exactly how it worked, and that was a profound technical skill. In the 1950s, if you were a computer

user, you were among the university elite.”

Just as now, technology moved on apace. By 1960 Lucifer was given a major upgrade, and four years later it was replaced. Sadly, few of the original components survive, though an identical model is on display at the Science Museum in London.

And though it was soon obsolete, Boyle says that that original investment led directly to an exponential growth in the use of computers in British universities, and paved the way for 50 years of technological growth. “By the 1960s Leeds was offering PhD and Masters degrees in computing and in the 1970s we were among the first universities to offer a single honours degree in the subject.”

At the time, our universities led the way in developing the skills for the burgeoning new industry. “Britain was right up there,” said Boyle, adding that it wasn’t until the late 1960s that

the emergence of the American giants began to put Britain in the shade. “And even though our technical lead faltered, we are still ahead in some areas of theory and science.”

He admits that computer courses have suffered something of an image problem in recent years. “Computing is no longer seen as glamorous. 20 years ago it was rocket science, but now computers are just so much part of everyday life and it isn’t seen as such an exciting subject to study,” said Boyle.

“That’s a shame, because the demand for our research and our graduates remains very high.”

The University of Leeds continues to be a centre of excellence for computer science, artificial intelligence and informatics and is staging a major event to mark its computing jubilee on Friday 30 March. Former staff and students, including some from the department’s pioneering early days, are returning to the campus to attend the event.

The celebrations will also include the award of an honorary doctorate of engineering to Emeritus professor Tony Wren in recognition of his world-leading work on transport scheduling – work that began on the original Leeds “brain machine”.

Full details of the computing jubilee event including a live webcast can be found at www.comp.leeds.ac.uk/jubilee/.

Visit the branch website at <http://yorkshire.iop.org>

Sheffield University researchers finally discover cosmic cannibals

Researchers at the University of Sheffield have discovered a new type of star whose existence has long been predicted, but had not been seen until now.

Unlike the Sun, which is a single star, about half of all stars in the sky are binary, where two stars orbit each other. In some of these binary systems, the two stars are so close to each other that they almost touch and the biggest star can strip material from its companion. Eventually, a point will be reached when the companion star has lost so much mass that it is no longer able to sustain nuclear fusion. It is this nuclear fusion that provides the energy for stars to shine, so the cannibalised companion finally becomes a faint, dead star, known as a brown dwarf.

For more than 20 years, theory held that many binary stars should evolve according to the above picture. Yet,



David Hardy and PPARC

Binary star systems make up about half of the stars in the galaxy.

despite numerous attempts by astronomers around the world to find these stellar cannibals, no such systems had been identified until now.

Dr Stuart Littlefair and

colleagues from the Department of Physics and Astronomy at the universities of Sheffield and Warwick took a new approach, searching instead for the eclipse as the faint brown dwarf crosses

the face of its much brighter companion. This takes less than a minute, so Littlefair had to use the high-speed camera ULTRACAM, developed by Dr Vik Dhillon at the University of Sheffield. By accurately timing the eclipse, the team showed that the companion is a brown dwarf with a mass of only 5% of the Sun's.

"It was beginning to look as if these systems either didn't exist or were too difficult to find using current telescopes. Finding this system was important because their existence had been predicted for so long but, try as we might, we couldn't find any of these cannibalised stars," Littlefair explained.

"This research not only confirms a long-standing theory but it also shows that we can actually find and study these objects, which will hopefully allow astronomers to learn a lot more about how stars die."

Got an idea for a branch event? If so, e-mail:

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Telescopes for all available online

The Bradford Robotic Telescope is a not-for-profit initiative by Bradford University. It has an extensive intelligent e-learning website focused on teacher support and exploiting real experiments with data that pupils obtain by using the robotic telescope on the island of Tenerife.

The government policy of distributing funds to schools means that the telescope team have to seek annual subscriptions from every school in the UK. The website (www.telescope.org/) is easy to use but its comprehensive set of teacher-support tools mean that self-taught users can easily miss many of the teacher resources.

The primary school teachers' preferred package is a £340 subscription that offers coaching in their own lessons. This includes two visits from a tutor – one to introduce the system to the staff and the pupils, and the second to assist



Left: the Bradford Robotic Telescope. Right: a picture of the Whirlpool Galaxy taken by Dennis Wigley with the telescope.



with the data analysis. The tutor receives an £80 honorarium for the two sessions.

This is an appeal for people with IT and astronomy skills to join us as science and engineering ambassadors to work with the Bradford Robotic Telescope. If you can visualise camping on the lunar surface and you know what the Earth and the stars will look like, and how that scene will change,

then you probably know enough about astronomy. These are the kind of people that we would like to recruit to help to introduce the Bradford Robotic Telescope to local schools.

For more details on the initiative or to register an interest in joining as an ambassador, e-mail ambassadors@telescope.org, or contact James Machell on 01274 235133 or John Baruch on 01274 243024.

A troubling time ahead

In his new book, *The Trouble with Physics*, Lee Smolin offers a powerful critique of string theory and the way we do physics. Physics, Smolin claims, is in trouble and the clear evidence for this is the lack of important new results in physics in the last 25 years. From the heady days of the early 20th century, the revolutionary phase of advance in physics is over and progress has become incremental. The main culprit, according to Smolin, is string theory which has steadily drawn the best and the brightest theoreticians to itself, to the exclusion of other approaches. Coming from a respected name in theoretical physics and someone who has worked extensively in string theory himself, this is a claim that we are obliged to consider seriously.

In support of his thesis, Smolin presents an engaging and fair-minded overview of the present status of the continuing search for a theory of everything. He weaves a pleasing mixture of historical narrative with sketches of some of the principal characters. The main achievement is that some often very esoteric and counterintuitive science is presented in a lucid way to the reader, and with no equations and barely a diagram in sight. He argues that the main failure of string theory is that it is either untestable, or where it is confronted with unexpected experimental data, this can only invalidate a limited subset of possible string theories but not the theory itself. As he rightly suggests, this is very different to most physical theories. Smolin implies that many of the practitioners of string theory are taking a cultish approach as they believe that the theory is beautiful and intrinsically right, and the fact that it is not experimentally falsifiable is not a serious problem.

What distinguishes this book from many similar works is that Smolin is not afraid to venture into a consideration of the societal issues that lie behind the trouble he

perceives in physics. This is dangerous territory for a scientist but he is careful to talk from experience and present positive suggestions to balance his sharp criticisms. Many of the criticisms he makes are probably universal and reflect more on human nature than anything particularly to do with physics. Physics professors, like all of us, promote and admire younger people in whom they see a little of themselves. This encourages conformity, but in a world where academic positions are hard to find, Smolin would claim, it almost guarantees it.

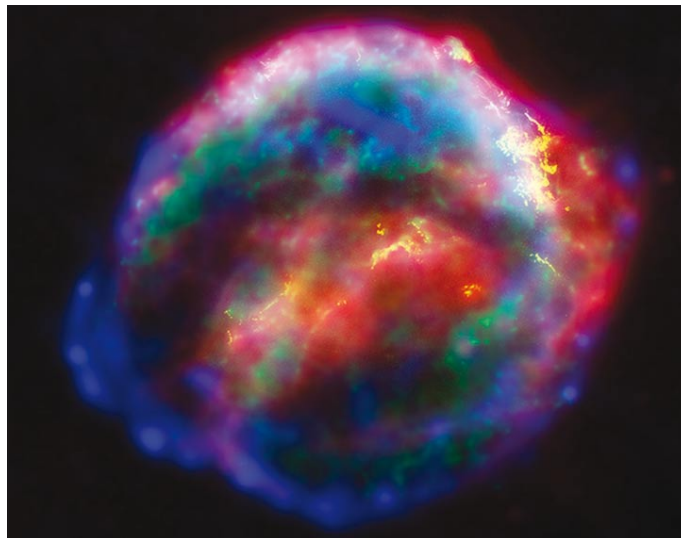
Many of the great names of physics were outsiders and free-thinkers. In our monolithic academic structures, there is no place for such people. If they are theoreticians interested in cosmology then they have two routes – the obvious one of string theory, or a lonely presence on the periphery. Smolin identifies the latter as seers and gives examples of the role such people can play. He feels that we need to promote risk-taking and adventure in research – he gives a personal plan of how best that can be achieved.

What then of Smolin's claim that physics is in trouble? In taking his stand, he seems almost like Churchill in the 1930s – one of the few who realises that the prevailing philosophy of the time is fundamentally bankrupt. It is a brave and contentious position to hold. Of course, the upheaval of the outbreak of the Second World War brought Churchill to the forefront and left appeasement in its wake. Will a similar revolutionary upheaval lead to string theory being discarded almost as quickly as it was adopted by the majority some years ago? We may not know for many years to come, but this book makes a very valuable contribution to opening the debate.

● *The Trouble with Physics* by Lee Smolin was published in hardback by Penguin Books on 5 March and costs £25.00.

David Jenkins

Clear view of the galaxy



Supernovae are expected to be sources of non-thermal excited particles. The High Energy Stereoscopic System has detected high-energy gamma rays from the supernova remnants RX J1713.7-3946.

A telescope system that has revolutionised astronomy and increased our understanding of the galaxy through high-energy gamma rays – a thousand billion times more energetic than normal light – has been awarded a share of the €1m (£683,000) European Union Descartes prize for research.

Dr Jim Hinton from the School of Physics and Astronomy at the University of Leeds is part of the High Energy Stereoscopic System (HESS) project, which brings together around 100 scientists from Europe and Africa. Since 2002, they have designed and built four telescopes in Namibia – an area known for its excellent optical quality – that detect cosmic gamma rays, revealing new details about celestial bodies far beyond the range of visible light.

The primary aim of the project is to explore the

production and propagation of high-energy particles in the universe. This area of study is referred to as the non-thermal universe, as the particles are not powered by thermal processes but by some as yet unknown non-thermal process. The best-known example of a non-thermal particle population are cosmic rays whose energies – up to 10^{20} eV and above – are well beyond the capabilities of any conceivable thermal emission mechanism.

Before the advent of advanced instruments such as HESS, there had been much speculation about these non-thermal processes, but very few sources had been identified or observed.

The funding awarded to the project will enable further exploration of possible sources, including supernovae, nebulae and binary star systems.

Please send articles for inclusion in the next issue of *Yorkshire Physics News* to:

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Institute of Physics 2007 Schools and Colleges' Lecture

Light Fantastic: the Science of Colour

- An exciting, interactive and inspiring free talk for school students. Builds on classroom knowledge to explain cutting edge technology.
- Light Fantastic: the Science of Colour will open pupils' eyes to the basic concepts of the science of light and colour to show how technology is making the most of light's astonishing properties.
- The presentation will include demonstrations, hands-on activities and movie clips to help shed light on the science of colour. We will explore the properties and characteristics of radiant electromagnetic energy and discover how the use of light has created the world we live in today and will shape the world we will live in tomorrow.

Audience: 14–16 year olds

Talk duration: 1 hour

Curriculum links include: Scientific Enquiry, Life Processes and Living Things, Materials and Their Properties, Physical Processes. For full links see www.iop.org

Dates in the Yorkshire Branch region

3 July, University of Leeds, 10.00 a.m.

4 July, University of Sheffield, Firth Hall, 2.00 p.m.

5 July, Hull Collegiate School, 11.00 a.m. and 2.00 p.m.

For more information please contact Alex Brabbs at alex.brabbs@iop.org or 01904 641488