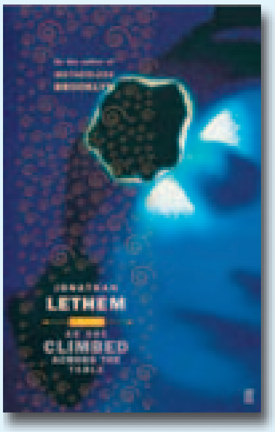
Big Bang Books



As She Climbed Across the Table

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Summary

A 'vacuum intelligence' created in an American physics lab is greeted with mixed reactions after it is established that it isn't immediately going to go anywhere or do anything. To the Nobel Prize winner for physics who led the experiment to open it, this hole is an embarrassment of a failed physics experiment. To the student societies, it's unfettered scientific advance. To particle physicist Alice Coombs, it's an intelligent entity she grows to love with a dangerous passion. To the book's narrator, Philip Engstrand, it's an unwelcome rival for Alice's affections.

Philip, whose PhD dissertation was on 'Theory as Neurosis in the Professional Scientist', and who now studies academic environments whilst producing 'strong but irrelevant work', guides the reader through the events immediately following the creation of the hole at the University of North California at Beauchamp. But whilst he's allowed to observe and later carry out his own metaphysical experiments on the hole, Philip is in the same position as most of his readers – he's an outsider, isolated by his lack of physics.

He's also in love with Alice. It's Alice who first realises that the hole displays signs of intelligence after it sucks some things into its void – a strawberry, mirrored sunglasses, a pair of argyle socks, a tabby cat – and rejects others including her love-struck self. As Alice's unrequited obsession with the hole – soon named "Lack" – grows, Philip begins a battle to win back his lover's soul.

So Lack rejects Alice as Alice has rejected Philip, and neither Alice nor Philip are able or willing to let go of what they believe they cannot live without, creating a bizarre love triangle in which the language of physics quickly becomes the language of love. "I'm not sure I really exist except under your observation," Philip tells Alice.

Particle physics, false vacuum bubbles and alternative universes all illustrate how a physicist can surrender to the passion that motivates them to carry on with an experiment, even when they fail to achieve the results they hope for. Both unrequited love and science can become an obsession – full of moments of potential glory, determination, boredom, and above all, misery.

Some science questions raised by the book

What is quantum physics?

Quantum physics is the branch of science that looks at how the smallest things, at the scale of atoms and below, behave. When we look at these small scales, we see that things are governed by probabilities – by the laws of chance – and this leads to some seemingly odd conclusions. But quantum physics allows us to make incredibly accurate predictions and it underpins much of our modern life including all modern electronic devices. Quantum mechanics, the mathematical rules of quantum physics, might be weird, but it's real.

What exactly is a 'false vacuum bubble'?

Contrary to popular belief, a vacuum is never totally devoid of stuff. One consequence of quantum mechanics is that a vacuum is actually a maelstrom of activity with particles and strange 'bubbles' continually appearing and then disappearing in a random fashion. So the vacuum of empty space-time isn't really a vacuum, it's a 'false vacuum' – and the bubbles that appear in it are 'false vacuum bubbles', full of space-time with curious properties.

Is it really possible to create a false vacuum bubble and a new universe in a lab?

Theoretically, yes, but the lab would have to be a high energy particle accelerator and even then it's not straightforward. The first challenge is that false vacuum bubbles appear randomly, so you could be in for a very long wait before one appeared. The second is that only the larger false vacuum bubbles are able to expand, becoming new universes. Smaller ones simply collapse inwards under the tension of their walls. And even if you were extremely lucky and a bubble of the right size appeared within your accelerator, you'd never be able to climb inside it. Whilst the bubble will expand, swelling the space-time within it to universal proportions, this growth is only noticeable inside the bubble. On the outside, where you would be, the bubble will stay the same size. The space-time within false vacuum bubbles has some very peculiar properties!

What is the 'observer problem' in physics?

More often called the measurement problem, this idea is exemplified by Schrodinger's Cat, a hypothetical experiment used by physicist Erwin Schrodinger to highlight one of the difficulties of the so-called Copenhagen interpretation of quantum mechanics. A cat is placed in a box with a radioactive particle which has a 50/50 chance of decaying. When the particle decays, a detector will release a cloud of poison gas and the cat will die. The problem is that without measuring, i.e. looking in the box, we don't know whether the particle has decayed or not and therefore whether the cat is alive or dead. Both the particle and the cat are said to be in a 'superposition' of two states. The particle is both not decayed and decayed, whilst the cat is both alive and dead. By opening the box and observing the situation, we force the situation to resolve itself and the particle and cat 'decide' which state to be in.

So an observer affects the outcome of situations; we affect what we are measuring. The problem is that no one knows what mechanism governs this affect – how does the particle know that we're looking? Fortunately, there are other interpretations of quantum mechanics, i.e. ways of relating the mathematics to the physical world that we observe, which don't rely on us giving particles powers of observation that we can't explain.

What are all those different spaces? (Cauchy, de Sitter, Minkowski and Schwarzschild)
The ordinary, three-dimensional space we are all familiar with (the up-down, left-right, backwards-forwards) is called Euclidean space after the ancient Greek mathematician Euclid. But this is actually only one of the many possible types of space that can be described using maths. The mathematical notion of space is much more general and abstract than our intuitive idea.

If we take the three spatial dimensions and add time, we get a four-dimensional space-time known as Minkowski space. And if we add another feature called the cosmological constant, which makes space expand, we get a space-time called de Sitter space.

A Schwarzschild space is a kind of spherically symmetric space – it has no centre and no boundaries, like the surface of a sphere. If you keep going in the same direction in a Schwarzschild space, you will eventually return to your starting point.

A Cauchy space is a general term to describe 'complete' spaces – spaces with no points missing. Euclidean space is an example of a complete space. To express the idea of 'completeness' of a space, we say that a sequence of points which get progressively closer to each other must eventually end in a point belonging to that space. The surface of a table is a complete space, but the surface of a sieve is not.

Does a radiation eating yeast really exist?
It's not a yeast, but Deinococcus radiodurans is a microbe that can withstand 1.5 million rads of radiation – a thousand times more than any other life form on Earth and 3000 times more than a human can survive. Its extraordinary tolerance makes it useful at nuclear waste sites, where it consumes nuclear waste and transforms it into more easily disposable products.

Do other universes really exist? How do we know?
Possibly. The mathematics of quantum mechanics suggests that other universes do exist, the problem is that there is no way of us detecting them.

Some scientists believe that the hypothesis of multiple universes (also known as the 'multiverse' theory) could explain why our own universe seems to be finely tuned to allow life to develop. According to this theory many universes exist, with widely different features, and only a small subset will have the right conditions for the appearance of intelligent life.

Critics reply that these theories cannot be considered scientific, since parallel universes are by definition unobservable, and thus cannot be the subjects of experiments, which are the backbone of scientific investigation.

Does blindsight really exist?
Yes. Some people cannot see because of damage to the main area of the brain devoted to processing visual stimuli, known as the primary visual cortex. However, their eyes work just fine. When asked to discriminate between different images, like vertical and horizontal bars, these people fare much better than would be expected from pure chance. This means that, although they are not consciously seeing, another part of their brain (called the extrastriate cortex) is still able to receive and process visual stimuli.

Some things to talk about

The idea of the 'observer problem' is recurrent throughout the book. How successful do you feel the author was in translating a technical problem to the wider themes of the book?

Alice is spectacularly subjective in her dealings with Lack which is at odds with the idea that scientists view their work objectively. Can scientists ever be truly objective and value free in their work? Would this be desirable?

The author attempts to use the language of physics to heighten Philip's feelings of exclusion and of being an outsider. Conversely, the physicists bond through their shared language and commitment in the face of the breakthrough. How successful was the author at creating this divide? How did it affect you?

Given the fantastical premise of the book, how realistic did the author make the characters? Was his portrayal of academics in general, and physicists in particular, sympathetic? In your experience, how are physicists normally presented?

Could you identify with any of the characters? What role did the secondary characters, eg Garth and Evan, play in the narrative?

Everyone who comes into direct contact with Lack seems drawn to 'him'. Why are we so intrigued by the idea of nothingness? Do you believe that Lack was truly intelligent? How would you define intelligence?

Did the author provide enough scientific information for you to understand the events in the story? Was pertinent information lumped together as 'the science bit' or integrated throughout the story? How did this affect your enjoyment of the book?

How does this book compare to others you have read? What, if any, will be your lasting impressions of the book? Would you be more likely to read a similar book in the future?

Some other books to read

Quantum Physics Cannot Hurt You *Marcus Chown*. ISBN 057123545X. Faber and Faber.
The Void *Frank Close.* ISBN 0199225907. Oxford University Press.
Gut Symmetries *Jeanette Winterson*. ISBN 1862070423. Granta Books.

Find out more about the physics in any book you read at www.physics.org – your guide to physics on the web.