

The Comprehensible Cosmos by Victor Stenger, Prometheus Books, ISBN 1591024242

WHERE do the laws of physics come from? It is one of the most fundamental questions in science. Most physicists say that nature's laws have an objective existence – that they exist “out there” in some Platonic realm, independent of human beings – but there is one who begs to differ. According to Victor Stenger of the University of Hawaii at Manoa, the laws that orchestrate the universe are human inventions. And that's not even his most controversial claim.

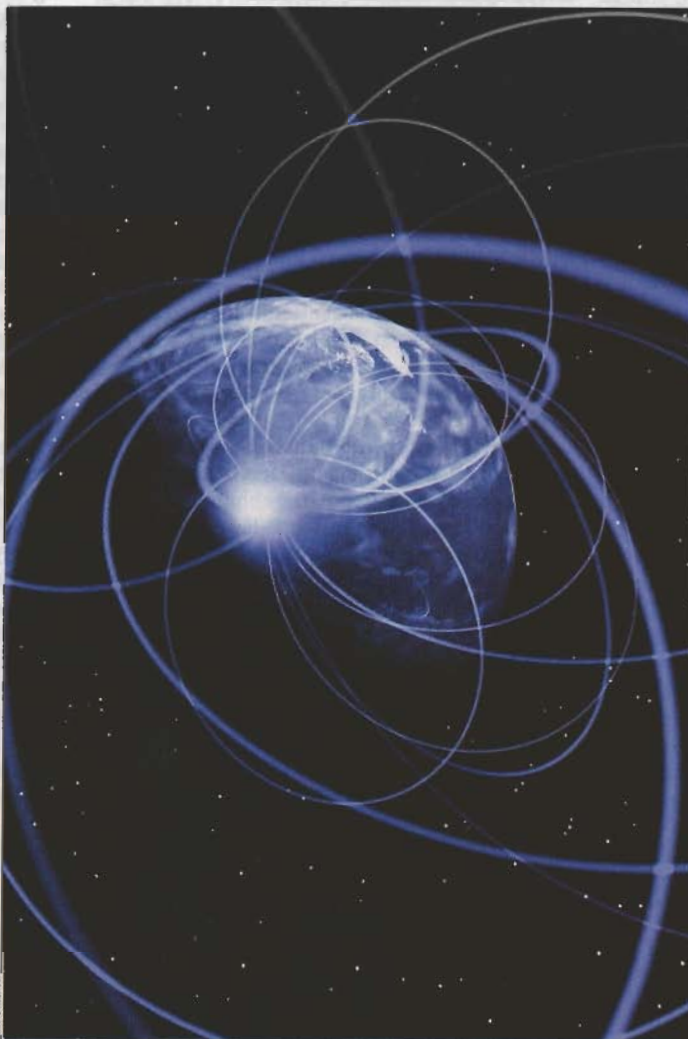
Stenger is not trying to belittle the laws of physics. He is as convinced as the next physicist that they are an immensely powerful means of encapsulating a vast range of natural phenomena in terms of simple relationships. Stenger, however, draws the reader's attention to the bedrock on which those laws are founded: symmetry.

Symmetry concerns itself with the aspects of an object that remain unchanged when something is done to it. A starfish, for instance, looks the same when rotated through a fifth of a complete turn about its centre, so it is said to have 72-degree rotational symmetry. In 1918, the German mathematician Emmy Noether made the surprising and remarkable discovery that many of the dynamical laws of physics are nothing more than consequences of underlying symmetries. For instance, the law of conservation of energy, which says that energy cannot be created or destroyed, turns out to be a direct consequence of time-translation symmetry – the fact that, all things being equal, you will get the same result if you carry out an experiment tomorrow as you did today.

Noether, who really ought to be a household name, had found what might be the single most powerful idea in science. For it turns out that symmetry is a guiding light that can lead us to new laws of physics. For instance, symmetries that Noether herself never dreamed of – those not of real space and time but of abstract

## OUT OF THE VOID

If the laws of the cosmos are the same as the laws of pure nothingness, says Marcus Chown, that could explain the greatest mystery of all – how something came from nothing



MERU KUNZKA

mathematical spaces – are responsible for the laws of quantum theory, the most wide-ranging and fruitful natural edicts ever known.

So if the laws of physics are based on symmetries, what does that really tell us? According to Stenger, it tells us that the laws are

The laws of the universe are by-products of an underlying symmetry

nothing more than a means of correlating phenomena so that they appear “independent of viewpoint”. There is nothing to stop us from writing down laws that are dependent on our

viewpoint – that are different in New York and London or from yesterday to today – but they would be far more complicated and difficult to use.

The laws of physics are simply human inventions motivated by our desire for a viewpoint-independent picture of the universe, Stenger argues. And that's just the beginning. Next he reveals the remarkable fact that the symmetries that lead to the laws of physics are exactly the same as those that would apply if the universe were completely empty. They are the symmetries of the void.

All of this leads Stenger to the biggest cosmic question of all: how did something come from nothing? The answer is simple, he says. Since the laws of physics are the laws of nothing, we require only nothing to come from

**“Something came from nothing because it is more stable than nothing”**

nothing, which is hardly a difficult step!

The universe may share the same laws as nothing, but it is categorically not a void. It has matter, energy and a vast amount of structure. Where did it all come from? Here comes Stenger's most contentious claim. Something came from nothing, he says, because something is more stable than nothing. In the beginning, there was the void, governed by the laws of the void, but the void changed into something more structured – rearranged nothing, if you like – just like featureless water changing into crystalline ice because at low temperatures ice is more stable than water.

This is heady stuff. You might find it hard to take in, but Stenger has written a fascinating and thought-provoking book. With 151 pages of technical supplements – nearly half the book – it is a feast for both the specialist and the dedicated general reader. ●