Hyperspace and a Theory of Everything

What lies beyond our 4 dimensions?

When I was a child, I used to visit the Japanese Tea Garden in San Francisco. I would spend hours fascinated by the carp, who lived in a very shallow pond just inches beneath the lily pads, just beneath my fingers, totally oblivious to the universe above them.

I would ask myself a question only a child could ask: what would it be like to be a carp? What a strange world it would be! I imagined that the pond would be an entire universe, one that is two-dimensional in space. The carp would only be able to swim forwards and backwards, and left and right. But I imagined that the concept of "up", beyond the lily pads, would be totally alien to them. Any carp scientist daring to talk about "hyperspace", i.e. the third dimension "above" the pond, would immediately be labelled a crank. I wondered what would happen if I could reach down and grab a carp scientist and lift it up into hyperspace. I thought what a wondrous story the scientist would tell the others! The carp would babble on about unbelievable new laws of physics: beings who could move without fins. Beings who could breathe without gills. Beings who could emit sounds without bubbles. I then wondered: how would a carp scientist know about our existence? One day it rained, and I saw the rain drops forming gentle ripples on the surface of the pond.

Then I understood.

The carp could see rippling shadows on the surface of the pond. The third dimension would be invisible to them, but vibrations in the third dimensions would be clearly visible. These ripples might even be felt by the carp, who would invent a silly concept to describe this, called "force." They might even give these "forces" cute names, such as light and gravity. We would laugh at them, because, of course, we know there is no "force" at all, just the rippling of the water.

Today, many physicists believe that we are the carp swimming in our tiny pond, blissfully unaware of invisible, unseen uni- verses hovering just above us in hyperspace. We spend our life in three spatial dimensions, confident that what we can see with our telescopes is all there is, ignorant of the possibility of 10 dimensional hyperspace. Although these higher dimensions are invisible, their "ripples" can clearly be seen and felt. We call these ripples gravity and light. The theory of hyperspace, however, languished for many decades for lack of any physical proof or application. But the theory, once considered the province of eccentrics and mystics, is being revived for a simple reason: it may hold the key to the greatest theory of all time, the "theory of everything."

Einstein spent the last 30 years of his life futilely chasing after this theory, the Holy Grail of physics. He wanted a theory that could explain the four fundamental forces that govern the universe: gravity, electromagnetism, and the two nuclear forces (weak and strong). It was supposed to be the crowning achievement of the last 2,000 years of science, ever since the Greeks asked what the world was made of. He was searching for an equation, perhaps no more than one-inch long, that could be placed on a T-shirt, but was so powerful it could explain every- thing from the Big Bang, exploding stars, to atoms and molecules, to the lilies of the field.

He wanted to read the mind of God. Ultimately, Einstein failed in his mission. In fact, he was shunned by many of his younger compatriots, who would taunt him with the ditty, "What God has torn asunder, no man can put together." But perhaps Einstein is now having his revenge. For the past decade, there has been furious research on merging the four fundamental forces into a single theory, especially one that can meld general relativity (which explains gravity) with the quantum theory (which can explain the two nuclear forces and electro- magnetism).

The problem is that relativity and the quantum theory are precise opposites. General relativity is a theory of the very large: galaxies, quasars, black holes, and even the Big Bang. It is based on bending the beautiful four dimensional fabric of space and time. The quantum theory, by contrast, is a theory of the very small, i.e. the world of sub-atomic particles. It is based on discrete, tiny packets of energy called quanta. Over the past 50 years, many attempts have been tried to unite these polar opposites, and have failed. The road to the Unified Field Theory, the Theory of Everything, is littered with the corpses of failed attempts. The key to the puzzle may be hyperspace. In 1915, when Einstein said space-time was four dimensional and was warped and rippled, he showed that this bending produced a "force" called gravity. In 1921, Theodr Kaluza wrote that ripples of the fifth dimension could be viewed as light. Like the fish seeing the ripples in hyperspace moving in their world, many physicists believe that light is created by ripples in five-dimensional space-time.

But what about dimensions higher than 5?

In principle, if we add more and more dimensions, we can ripple and bend them in different ways, thereby creating more forces. In 10 dimensions, in fact, we can accomodate all four fundamental forces! Actually, it's not that simple. By naively going to 10 dimensions, we also introduce a host of esoteric mathematical inconsistencies (e.g. infinities and anomalies) that have killed all previous theories. The only theory which has survived every challenge posed to it is called superstring theory, in which this 10 dimensional universe is inhabited by tiny strings.

In fact, in one swoop, this 10 dimensional string theory gives us a simple, compelling unification of all forces. Like a violin string, these tiny strings can vibrate and create

resonances or “notes”. That explains why there are so many sub- atomic particles: they are just notes on a superstring. (This seems so simple, but in the 1950s, physicists were drowning in an avalanche of sub-atomic particles. J.R. Oppenheim- er, who helped build the atomic bomb, even said, out of sheer frustration, that the Nobel Prize should go to the physicist who does NOT discover a new particle that year!) Similarly, when the string moves in space and time, it warps the space around it just as Einstein predicted. Thus, in a remarkably simple picture, we can unify gravity (as the bending of space caused by moving strings) with the other quantum forces (now viewed as vibrations of the string).

Of course, any theory with this power and majesty has a problem. This theory, because it is a theory of everything, is really a theory of Creation. Thus, to fully test the theory requires re-creating Creation! At first, this might seem hopelessly impossible. We can barely leave the earth’s puny gravity, let alone create universes in the laboratory. But there is a way out to this seemingly intractable problem. A theory of everything is also a theory of the everyday. Thus, this theory, when fully completed, will be able to explain the existence of protons, atoms, molecules, even DNA. Thus, the key is to fully solve the theory and test the theory against the known properties of the universe. At present, no one on earth is smart enough to complete the theory. The theory is perfectly well-defined, but you see, superstring theory is 21st Century physics that fell accidentally into the 20th century. It was discovered purely by accident, when two young physicists were thumbing through a mathematics book. The theory is so elegant and powerful, we were never “destined” to see it in the 20th century. The problem is that 21st century mathematics has not yet been invented yet. But since physicists are genetically predisposed to be opti- mists, I am confident that we will solve the theory someday soon. Perhaps a young person reading this article will be so inspired by this story that he or she will finish the theory. I can’t wait!