Unit Two: The Music of Our Existence

Chapter six: Nature's Hidden Tunes

String theory is a highly disputed topic among today's physicists because it predicts something that we can not and may never be able to directly see, bearing on if new, sufficient probing techniques are invented. It is, however, the most comprehensive foundation of physical theory that currently exists, *by far*.

In 1968 string theory was born in the minds of two particle physicists, Yoichiro Nambu and Roger Nielson, who were attempting to incorporate the strong force into quantum electrodynamics. After about two decades of theoretical evolution, string theory was shown to have the ability to incorporate general relativity into a quantum mechanical framework. Actually, it *predicts* the need for gravity as we know it. Much of the deliberation about string theory stems from this ability and the perhaps naive conclusion that we create from it - that this is the final theory. The cautionary side assumes that string theory might be one of more, if not many different theories that can yield the same, pleasing result. After all, the entire theme of science is to wait and prove something beyond assumption and bias, so such a label is premature. Once every aspect has been proven beyond doubt, this label can finally be assumed.

So what *is* string theory, the possible theory of everything? String theory is based on the idea that our current view of elementary particles is merely an illusion. The zero-dimensional, point particle view of mechanics is reinterpreted as swiftly moving, one-dimensional strings of energy. Just as one will get an unpleasant surprise if one quickly jab's one's finger into an electric fan, the blades (the string) move so fast that our probes will always bounce off. They move so fast, they appears to be a solid objects, but one's finger, if in the wrong place at the wrong time, may prove otherwise. Everything is composed of and operates as the result of massive amounts of elementary strings.

If all of the strings composing, let's say, a wall are stationary, at the right time, when all of the strings permit it, we theoretically could walk right through it! We wouldn't realize that the wall existed at all! As strings are mobile, they are capable of residing in more than one position, and therefore aren't always occupying the entire volume of the spherical shape that we once naively referred to as a point. In fact, they never occupy more than a very, very small fraction of their spheres. Theoretically, if a string can travel fast enough and at precisely the right time, it can pass right through the spherical shape, like light through a fan. This extremely rare occurrence is called *quantum tunneling*. In this concept, it is technically possible for a human to walk right through a wall, or to fall through the ground, although the probability of such occurring is insanely unlikely.

A string's ability to assume different properties arises from its specific mode of oscillation. All masses and force charges, according to the theory, are just one of the ways that a string can vibrate, similar to a variety of guitar strings. A string's energy complies with Planck's constant in the same way that electromagnetic radiation does (as they are one in the same): they can only vibrate at rates that are whole number denominations. The tension that these strings are held to is a reformation of this constant called the *Planck tension* (10^{34} tons.) This is similar to guitar strings, except the nut that holds the elementary strings down is gravity's pull.

The entirety of the universe, being based on strings, is a giant tree of cause and effect originating from the big bang. In this tree, changes occur to its strings through collisions and cancellations. For example, when a string and its *anti-string* (antimatter) collide, their charges cancel each other out and their properties imbue into pure, photonic energy. Then, if they are able to borrow energy from their environment, they can split again into two new strings. This tree of string-based cause and effect relationships forms our destiny (more in the later books), which some physicists refer to as the *world sheet*.

Why does energy take on the form of strings and not some other form? String theory did not originate in the mind of someone who just imagined that energy may be in a stringy form, who then went on to create a theory based around this idea. "String theory" was discovered before anyone even realized that it *was* a theory of strings. Nambu and Nielson's research yielded the "string" conclusion from mathematical evidence when they were still viewing reality in a point particle perspective! The seemingly flawless theory resulting from their math, however, is the only evidence that these strings really do exist, albeit it *is* strong evidence. We would need a particle accelerator the size of the known universe to actually see individual strings, so physical evidence must be found by indirect means, like math. But, if strings *are* what truly composes everything, certain *indications can be observed* without such immense magnification. We don't currently possess a large enough particle accelerator to see these indications, as of yet. Two of which, however, are currently in the making.

Sometime before 2010 in Geneva, Switzerland, a new, gigantic particle accelerator called the Large Hadron Collider will be built. With this tool, we will gain the ability to see the indications of the existence of strings, possibly finding the first physical evidence for string theory. The collider will also have the ability to detect dark matter and superpartner particles (which will be discussed in Chapter fourteen and the next chapter, respectively), among other possible discoveries.

The United States' answer to this is an even more massive collider, which may or may not eventually be completed. The Superconducting Supercollider, as it is called, has been in the construction progress in Ellis County, Texas for some time now, but funding keeps fluctuating and disappearing due to the government's poor funding choices. The collider stretches over fifty miles in an excavated chalk trench over ten feet wide, making it the largest partially-built accelerator in the world. This tool could do everything that the Large Hadron Collider could do, plus much more. Undoubtedly, its gifts will greatly outweigh its costs and will greatly change our technological perspectives for the better.

Despite being a relatively young theory, string theory has already been the cause of amazing amounts of scientific advancement. Although conceived in 1968, its time in the limelight has been greatly less. The theory was quickly forgotten after its birth because of the introduction of quantum chromodynamics, which was a monumental and side-tracking shift in the world of physics. Nambu and Nielson were trying to add the strong force to quantum electrodynamics, and since that's what quantum chromodynamics was found to do, it cancelled the immediate need for their research. String theory wasn't resurrected until 1984 in what is now called the first superstring revolution, which is where we will begin our study of the theory.