Space and Change

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From the ancient Greek, questions about space have risen. Conflicts such as whether there is a change or not occurred between philosophers. For instance, Zeno of Elea, an ancient Greek philosopher, produced many paradoxes to prove that there is no change in the world. In this paper, I will take into account these paradoxes, and I will show the possible responses to these paradoxes. In addition to Zeno, Aristotle discussed his view about the nature of the Universe; he gave his interpretation concerning the shape of the universe, and whether the universe possesses a boundary. In addition, I will discuss Archytas's objection to Aristotle Universe. Further, I will take into consideration some of the responses to Archytas, and later I will reflect on these responses.

I will begin by stating Zeno's argument against space. There is no clear statement about Zeno's argument against space. But since he argued that there is no change, someone can infer that space is static and any movement or exploration for this space is simply impossible. Zeno's paradoxes take multiple forms. However, the main idea behind his paradoxes is that accomplishing a task which consists of an infinite number of tasks in a finite time is simply impossible. A version of his paradoxes is the dichotomy which arises after an infinite division by two (Page 18). For instance, finishing a run that consists of 100 meters can be paradoxical if you think about it in the following way. First, to run the 100 meters, you have to run the 50 meters, and to run the 50 meters you have to run the 25 meters, and so on. Therefore, if each time we take half of the previous track and treat it as one entity, and apply the same division process, crossing any entity in a finite time will be impossible because each one requires accomplishing an infinite number of tasks. Furthermore, the runner will not be able to cross any entity, and he/she will be immobilized. This argument led Zeno to conclude that any movement or change is impossible.

In this paragraph, I will address some of the responses to Zeno paradoxes that I mentioned above. A simple response to Zeno is just standing up and walking to prove him wrong like what Diogenes the Cynic managed to do. However, Zeno's response to such refutation is denying the credibility of the senses, and consider what we are seeing a kind of hallucination. But a better response to Zeno can be made. First, Zeno in his paradoxes is trying to apply the method of summing a finite amount of things to infinite amounts. It turned out that the way to deal with an infinite sum is different from that of a finite sum. Therefore, Zeno and the ancient Greeks lacked the tools that allowed them to find the result of an infinite sum. Later on, these tools discovered by Cauchy. After this discovery the problem that an infinite number of tasks need an infinite amount of time is resolved. For instance, if running 100 meters need one unite of time, half of it will need half of the amount, and half of the half will need the half of the amount of time, and so on. Since, we will end with an infinite amount of time to be added, Zeno though this will end with an infinite amount of time. However, the true sum will not be equal to infinity but it will be finite because it will be similar to the following sum $(1/2 + 1/4 + 1/8 + \dots)$ which proved equal to one by Cauchy sum. Therefore, Zeno argument that an infinite amount of tasks cannot be accomplished by finite time is completely irrelevant.

Now, I will shift to talk about Archytas argument against Aristotle's model universe. First, what is Aristotle's model? Aristotle considered the universe as a closed sphere which means that the surface of the sphere is including with the universe, not just what exists inside the ball (Page 33). This definition for the universe implies that the universe possesses a boundary. Aristotle model states that outside this sphere there is absolutely nothing, neither void nor place (Page 33). This view of the universe seemed to be problematic for Archytas; he wondered that if you stick your hand or not outside the sphere there will be a place out

there. Since there is a place for the hand outside the ball, and by the definition of space as the collection of all possible places, space would not have any boundary as Archytas claims.

Several responses are proposed against Archytas argument. First, an expanded version of the Aristotle model universe is proposed. This response indicates that whenever we try to stick our hand outside the ball, the universe will expand. However, an expending edge is not an edge at all which implies that the universe is infinite (Since we can expand it infinity many times). Another response is the possibility of the existence of an impenetrable barrier outside the universe. The issue is this response is the nature of this barrier. Suppose that this barrier is a wall, therefore if this wall if finitely big then one could argue that any finite big thing can be penetrable since it will consist from a natural material, and you can penetrate it in a finite amount of time. However, one can still argue about the existence of such a force field generated by special material of finite thickness that plays the role of the barrier. Finally, a response that does not need that existence of a barrier at the edge is Poincare Universe. Henri Poincare proposed a model of the universe where approaching that edge could be impossible because of the existence of shrinking factors. For instance, the object will shrink by factor 1 − w2 where w is between zero and one, and it represents the fraction towards the edge (Page 34). Therefore, any trial using a fine speed to escape this universe seems impossible because the speed of shrinking will increase with increasing your speed. In addition, trying an infinite speed would be also problematic. First, an infinite speed is not allowed in the universe according to Einstein special theory of relativity. But let's assume that infinite speed is possible and allowed. However, the shrinking factor will still affect the runner even if he will attain the edge he will become a negligible point where he cannot cover any distance. Moreover, a point does not have an extension, so it cannot be extended or stretched apart from it outside the universe (There will be no hands to stick). A completely different response could be that the universe is just the surface of a sphere similar to a two-dimensional surface (Page 37). Such a universe is closed up; the edges are joint back to each other (Page 38). For instance, traveling to the end of the right will lead us to the beginning of the left.

In the current paragraph, I will reflect on the responses to Archytas argument. Firstly, the response that claims that there exists a force field or special force that disallows us from sticking our hand outside the universe is more convenient. First, there is a scientific model such as the Einstein general theory of relativity that allows us to take this responsibility seriously. In addition, the existence of strange energy called dark energy that plays a role in holding the galaxies could give us the intention of possible strange forces in the universe. Moreover, the black holes and the way they prevent light and all sort of matters from escaping from his field show us that the universe could contain barriers that prevent matters from escaping or moving forwards. Secondly, the response that the universe is the surface of a sphere, and its edges are joined together seems problematics. Because the edges of the surfaces are joined, to allow such a joint we need an extra dimension, then the universe is embedded in four dimensions, Further someone could ask whether the edge toward that new dimension is joint or not, it is joint then we still need another extra dimension. Other with it is better to do not have a joint edge in that extra dimension, thus Archytas will be able to stick his hand outside the universe if he had the power to go toward the edge of the extra dimension.

In conclusion, through this article, I address Zeno's argument against space and change, and then I show some of the responses to Zeno's argument. Next, I shift the discussion toward Aristotle's model of the universe and especially about Archytas's argument against Aristotle. Furthermore, I take into account the responses to Archytas's arguments such as the existence of a barrier at the edge of the universe, Poincare Universe, and the possibility that the universe is surface. In the end, I reflect on these responses by showing which one is more or less convenient.

The dimensionality of space is a major conflict in physics and philosophy. In this short essay, I will try to explain how the world may have small compact dimensions starting from explaining the idea behind Flatland. First of all, Flatland, as its name denotes, is a two-dimensional surface. In addition, a two-dimensional creature is living in this land. However, this creature has access to a third dimension. His ability to access this extra dimension allows him to do extraordinary things such as escaping a locked room. Or reading a two-dimensional letter by looking at a mirror locking in the extra dimension. Now, Imagine that our three-dimensional world has extra dimensions, then If we could access this extra dimension, we could do an extraordinary thing like the creatures of the flatland. For instance, we can take a loop of string in the three dimensions and tie a knot in it, this trick is impossible if we just have three dimensions (Page 46). String theory has the same idea, the extra dimensions exist (The universe have at least nine dimensions) (Page 48), but with one exception, these dimensions are too small, and three of them are dominant, the other non-dominant dimension we call them compact dimensions. Since these dimensions are too small, the occurrence of an event is unlikely. Detecting these dimensions is complicated. For instance, let's say that in these dimensions of pass your hand from one side, it will appear on the second side. Therefore our hand is flipped constantly through these small dimensions. However, feeling the pain is impossible because the event happens very quickly in these dimensions due to their tiny size, so the nerves are unable to detect the pain. In conclusion, String theory predicts the existence of compactified dimensions that are undetectable due to their tiny size.

Bibliography

All the citations refer to, "Everywhere and Everywhen, Adventure in Physics and Philosophy", By Nick Huggett.