Mysteries of Modern Science

A. Nanayakkara

In this article, four unusual scientific phenomena are described. They are very different from our day-to-day experiences but have solid scientific ground with ample experimental evidence to support them.

Viruses *(Are they alive?)*

Viruses are little more than a coat of protein surrounding one or more nucleic molecules. The nucleic acid (DNA or RNA) of a virus when inserted into a host cell, can convert its host into a factory assembling and releasing viruses of the same kind. Viruses can be considered as non-living entities when they are outside of a living cell because they do not carryout any basic biological activities of a living organisms. However, when viruses are in a living cell, they become active performing biological activities such as reproduction. Can we say viruses are living beings?

Fibonacci Numbers *(Unusual patterns in nature!)*

The Fibonacci numbers form a fascinating sequence first described in the 13th centaury by the Italian mathematician, Leonardo Fibonacci, after whom they are named. Fibonacci sequence of numbers can be formed by starting with any two numbers and obtaining subsequent numbers by adding the two proceeding numbers in the sequence. As an example
1, 1, 2, 3, 5, 8, 13,.....

forms a Fibonacci sequence and so does the sequence 15, 21, 36, 57, 93, 150.....

Fascinating feature about Fibonacci sequence is that they turn up in the most unexpected area: to name a few - in Chemistry, Botany, Architecture, and even in celebrated paintings.

The famous problem which Fibonacci described, concerns rabbits and their growth. A male-female pair of rabbits is kept in an enclosure. New pair does not yield progeny till the end of its first month; every pair thereafter gives male female pair each month. Assuming that none of the pairs dies and that original pair bears its first pair in the first month, how many pairs will there be at the end of one year? It turns out that the number of pairs in the enclosure at the end of each month - 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377 - is always a Fibonacci number.

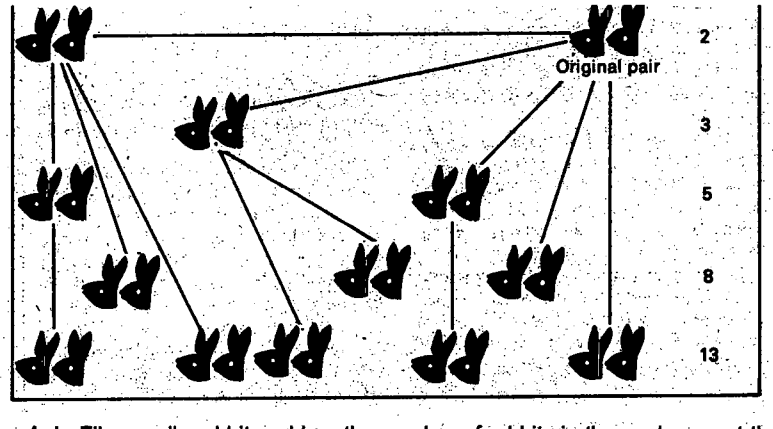

Figure 1. In Fibonacci's rabbit problem the number of rabbits in the enclosure at the end of every month is a Fibonacci number. The figure shows the growth of rabbits at the end of each month for the first five months.

Fibonacci numbers appear in many instances in plant growth and structure. Take a pineapple. It has a number of "eyes", wart-like thorny projections, on its surface. The eyes are arranged in two sets of spirals, one moving clockwise and the other in a counter clockwise direction. The number of spirals measured in one direction and that in the other direction are invariably consecutive Fibonacci numbers (Figure 2). Fibonacci numbers also turn up inside atoms.

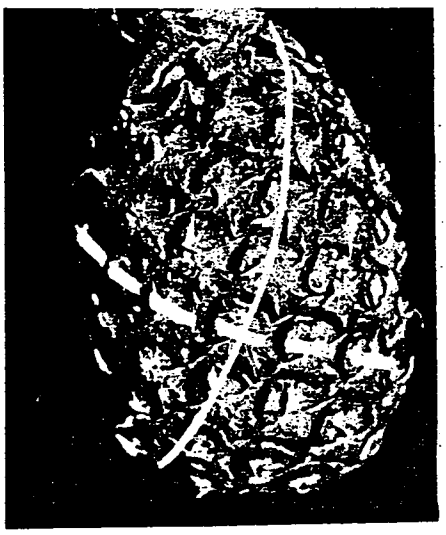

Figure 2. This pineapple has 8 spirals in the direction parallel to the dotted line and 13 in that parallel to the solid line, Both are Fibonacci numbers

Atomic Structure ***(Elusive electrons!)***

Scientists knew for a long time that atoms are made of electrons and protons. However, the motion of them in atoms had not been understood until the invention of Quantum theory. Experimental evidence suggests that all the protons are located at the center of the atom, which is called the nucleus, but does not give any indication about the motion of electrons. In order for an atom to be stable, according to Newtonian mechanics, electrons should travel around the nucleus like planets travel around the Sun. But this model fails due to the fact that when electrons revolve around nucleus, they must emit radiation like any other accelerating charged particle. This would cause electrons to loose their kinetic energy and finally collapse in to the nucleus. However, experimental evidence does not support this scenario. Also electrons cannot be stationary as nucleus is pulling them towards it by electrostatic force. Therefore, electrons cannot be stationary nor can it revolve around the nucleus. Then the question is " What is wrong here?" The answer lies in the fact that electrons are very small and Newtonian mechanics does not describe the behavior of such small particles. According to Quantum mechanics, which is the correct theory for describing behavior of small particles, inside an atom, electrons do not behave like particles, but they behave like waves. When we do not observe them, existence of physical quantities such as position, energy and angular momentum have no meaning. However, when we observe or measure, them, values we get for energy and the angular momentum fully agree with the values predicted by Quantum Mechanics.

Time Travel ***(Science or Science fiction?)***

For thousands of years, scientists and philosophers have talked of time as a river that flows steadily onward year after year. But what if there were a way to swim against the flow, or to run down the bank ahead of the river? Might we be able to journey back and forth in time just as we travel through space? The idea is not as far-fetched as it sounds, and the implications for the future are intriguing.

According to current level of understanding of physics, traveling both forward and backward in time is possible. In order to journey to the future, according to the special theory of relativity, the only thing one has to do is to travel at high speeds. If one can travel close to the speed of light, he can travel to any day in the future. Although travel to the future is not restricted by physics, present understanding of Quantum mechanics and Relativity indicates that travel to the past is possible but restricted. According to recent developments in theory of Wormholes, it is possible to travel to the past until the time when the time machine was constructed. In other words, if we make a time machine today, this time machine can only be used in the future and one cannot travel back to the past earlier than today (e.g. The person can travel back to tomorrow but not to yesterday). However, there are paradoxes (logical inconsistencies) which may entirely forbid travel back in time.

Scientists say building a time machine may be extremely difficult. But time travel is not against the laws of physics!