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Mysticism in the Fractal Structure of the Universe

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Abstract

In this paper a critical enquiry is made into the mystical dimension of science with specific reference to contemporary developments in *fractal* Geometry. The paper begins with a historical synthesis of the mystical roots of scienace to see how science lost its mystical nature, especially in the modern era, corresponding to the emergence of a dualistic world-view in philosophy. However, contemporary science, very specially 'fractals', takes us to a mystical realm in which the dichotomised world-views of matter-spirit, finite-infinite, microcosm and macrocosm are blurred. Such a mystical understanding re-defines and transcends the traditional understanding of mysticism which is confined to the sacred spheres.

01. Introduction

The contemporary science leads us today to a worldview which is essentially mystical and relational. In a way, it is a return to its

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beginning, 2,500 years ago.[1] The roots of all Western science are to be found in the first period of Greek philosophy in the sixth century B.C., in a culture where science, philosophy and religion were not separated. The sages of the Milesian school in Ionia were not concerned with such distinctions. Their aim was to discover the essential nature, or real constitution, of things which they called '*physis*'.[2] They saw no distinction between animate and inanimate, spirit and matter. In fact, they did not even have a word for matter, since they saw all forms of existence as manifestations of the '*physis*', endowed with life and spirituality. Thus, Thales declared all things to be full of gods and Anaximander saw the universe as a kind of organism which was supported by '*pneuma*', the cosmic breath, in the same way as the human body is supported by air.

The mystical thought is even stronger in the philosophy of Heraclitus of Ephesus.[3] Heraclitus believed in a world of perpetual change, of eternal 'Becoming'. For him, all static Being was based on deception and his universal principle was fire, a symbol for the continuous flow and change of all things. Heraclitus taught that all changes in the world arise from the dynamic and cyclic interplay of opposites and he saw any pair of opposites as a unity. This unity, which contains and transcends all opposing forces, he called the *Logos*. The split of this unity began with Parmenides of Elea who was in strong opposition to Heraclitus. He considered change to be impossible and regarded the changes we seem to perceive in the world as mere illusions of the senses. The concept of dualism grew out of his philosophy and became one of the fundamental concepts of Western thought. In subsequent centuries the dualistic world-view remained unchallenged and the dualism reached its peak in the seventeenth

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1 Cf. Fritjof Capra, *The Tao of Physics: An Exploration of the Parallels Between Modern Physics and Eastern Mysticism*, Flamingo, 1992, 24. Hereafter this book will be abbreviated as *TP*.

2 Fritjof Capra, *The Tao of Physics*, 24. The term 'physics' is derived from the Greek word 'physis' and meant therefore, originally, the endeavour of seeing the essential nature of all things.

3 Fritjof Capra, *The Tao of Physics*, 25.

century with Rene Descartes. Descartes based his view of nature on a fundamental division into two separate and independent realms; that of mind (*res cogitans*), and that of matter (*res extensa*).[4] The 'Cartesian' division allowed scientists to treat matter as dead and completely separate from themselves, and to see the material world as a multitude of different objects assembled into a huge machine. Such a mechanistic world view was held by Isaac Newton who constructed his mechanics on its basis and made it the foundation of classical physics.

Newton's equations of motion are the basis of classical mechanics.[5] The 18th and 19th centuries witnessed a tremendous success of Newtonian mechanics in the form of the development of the Mechanical Philosophy of Nature (MPN). This theory affirmed the

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4 Cf. Capra, TP, 27. Descartes' famous sentence 'Cogito ergo sum' - 'I think, therefore I exist' - has led Western man to equate his identity with his mind, instead of with his whole organism. As a consequence of the Cartesian division, most individuals are aware of themselves as isolated egos existing 'inside' their bodies. The mind has been separated from the body and given the futile task of controlling it, thus causing an apparent conflict between the conscious will and the involuntary instincts. The fragmented view is further extended to society which is split into different nations, races, religious and political groups. The belief that all these fragments - in ourselves, in our environment and in our society are really separate can be seen as the essential reason for the present series of social, ecological and cultural crises. It has alienated us from nature and from our fellow human beings. The Cartesian division and the mechanistic world view have thus been beneficial and detrimental at the same time. They were extremely successful in the development of classical physics and technology, but had many adverse consequences for our civilization.

5 Cf. "Newton's Laws of Motion," in *http://en.wikipedia.org/wiki/Newton%27s_laws_of_motion*, accessed on 10-05-2010. Newton's laws of motion are three physical laws that form the basis for classical mechanics. They have been expressed in several different ways over nearly three centuries, and can be summarised as follows: a. In the absence of a net force, a body either is at rest or moves in a straight line with constant speed. b. A body experiencing a force F experiences an acceleration a related to F by $F = ma$, where m is the mass of the body. Alternatively, force is equal to the time derivative of momentum. c. Whenever a first body exerts a force F on a second body, the second body exerts a force "F on the first body. F and "F are equal in magnitude and opposite in direction.

Newtonian view and believed in the mechanistic explanation of the natural phenomenon. According to MPN, the universe is a gigantic machine which functions like a clock.[6] All living beings in the universe are nothing but machines. Their structure and operations are being governed by the basic theories, concepts, methods, and criteria of the science of mechanics. Mechanical explanation meant explanation in terms of matter in motion and interaction between material particles. It led to a large-scale reduction of all organisms in the universe, including the human body and human beings themselves, to mere machines. All organic activities, including the complex life-processes were reduced to interaction of material particles in motion. Such mechanization meant that science could give us absolute accuracy, absolute certainty, exact predictability. The universe was considered deterministic. This also meant that scientific knowledge was perfectly objective, being valid for all persons, at all times and in all places. The subjective and personal elements could have no place in science. Scientific knowledge was considered perfectly rational, irrational elements like feelings emotions, etc., having no place in science. The MPN collapsed towards the end of the 19th century under its own weight: it claimed to do too much, but was unable to explain even the common phenomena like sensation, irritability, etc. However, in many ways it reincarnated in the form of Logical Positivism (LP) in the twentieth century. According to LP all true knowledge must be based on empirical experience and the scientific truths were considered permanent and immutable.[7]

However, it is fascinating to see that twentieth century science, especially the theory of relativity and the quantum theory in physics, which originated in the Cartesian split and in the mechanistic world view overcame the fragmentation and led back to the ideas of unity and relation expressed in the early Greek and Eastern philosophies.

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6 Kozhamthadam, "The Changing Face of Science Christianity Dialogue," in *Science, Technology and Values*, Edited by Job Kozhamthadam, ASSR Publications, Jnana-Deepa Vidyapeeth, Pune, 2003,18-20.

7 Kozhamthadam, "The Changing Face of Science Christianity Dialogue," 21.

It is within this historical trajectory we place the fractal Geometry to show the mystical dimension of science.

02. What Are Fractals?

A new branch of geometry has been developed to explore the material reality, which are called 'fractals'. The Polish born American Mathematician Benoit Mandelbrot coined the word fractal in 1975, where fractals refer to the traces, tracks, marks, and forms made by the chaotic dynamic systems.[8] The study of fractals has discovered striking mathematical patterns that repeat in an astonishingly wide variety of phenomena, from the formation of galaxies to rugged coastlines, from unpredictable weather currents to flow of blood in the human body. Wherever there is turbulence and disorder, scientists discover complex forms of remarkable detail and mathematical proportion that repeat on greatly different scales from the very large to the microscopic.[9]

The term fractal is rooted in the Latin *fractus*, meaning "broken" or "fractured." "How long is the coast line of Britain?" is a landmark discourse in science, presented by Benoit Mandelbrot.[10] At first thought the answers would seem to require measurements of photographs taken from an orbiting satellite or for greater accuracy, from an aircraft flying along the coast, or for complete accuracy, by walking along the coastline with a measuring tape. However the answers obtained were successively closer approximations of the length of Britain's coastline. Mandelbrot pointed out that the length obtained depended o the resolution of measurement, that is, the size of the smallest bend seen on the photograph or measured on

[8] Lesmoir-Gordon, Nigel, Will Rood and Ralph Edney (ed.), *Introducing Fractal Geometry*, Icon Books, Cambridge, 2000, 4.

[9] Kuruvilla Pandikkattu, *The Bliss of Being Human*, Jnana-Deepa Vidya Peeth, Pune, 2004, 52.

[10] Lesmoir-Gordon, Nigel, Will Rood and Ralph Edney (ed.), *Introducing Fractal Geometry*, 15.

site. Consequently a coastline does not have a determinable length. Analogously nor does a river have a determinable length.

If we analyse the curve of a coastline or the course of a river, we will find that, when magnified, parts of the curves are identical with the whole, or nearly so; with a certain scale of magnification, the pattern will repeat itself. Similarly the more picture of a cloud is magnified the more we will be aware of a seemingly endless piling up of forever smaller structures that repeat the general shape of the cloud. The universe is replete with shapes that repeat themselves on different scales within the same object. According to Mandelbrot such objects are said to be self-similar. In the idealized world of Mathematics, there are several well-defined figures that are self-similar and an infinite number of such figures could be generated through iteration of functions. Those figures have quite unexpected properties, such as a boundless perimeter enclosing a finite area, or a boundless surface area containing a zero volume; the explanation lies in the fact that these features do not belong within the human experience of a three-dimensional universe. It is in this context that Mandelbrot introduced the concept of fractals.

03. Features of Fractals

A fractal is a shape that is recursively constructed or self-similar. That is, a shape that appears similar at all scales of magnification and is therefore often referred to as "infinitely complex." Mathematicians avoid giving the strict definition and prefer to call fractal a geometric shape with the following properties:[11]

- Natural appearance
- Cannot be described in traditional Euclidean geometry
- Repetitive
- Self- similar at all scales of magnification

[11] Cf. *Fractals: An Introductory Lesson* in http://www.arcytech.org/java/fractals/, accessed on 20-04-2010.

- Finite structure but infinitely complex
- Fractal Dimension
- Explanation with Algorithm

Fractals have all or most of these features. Not all self-similar objects are fractals - for example, the real line (a straight Euclidean line) is formally self-similar and has natural appearance but fails to have other fractal characteristics.

04. Classification of Fractals

Fractals can also be classified according to their self-similarity. There are three types of self-similarity found in fractals:

— Exact self-similarity - This is the strongest type of self-similarity; the fractal appears identical at different scales. Fractals defined by iterated function systems often display exact self-similarity.

— Quasi-self-similarity - This is a loose form of self-similarity; the fractal appears approximately (but not exactly) identical at different scales. Quasi-self-similar fractals contain small copies of the entire fractal in distorted and degenerate forms. Fractals defined by recurrence relation are usually quasi-self-similar but not exactly self-similar.

— Statistical self-similarity - This is the weakest type of self-similarity; the fractal has numerical or statistical measures which are preserved across scales. Most reasonable definitions of "fractal" trivially imply some form of statistical self-similarity. Fractal dimension itself is a numerical measure which is preserved across scales. Random fractals are examples of fractals which are statistically self-similar, but neither exactly nor quasi-self-similar.

05. Fractal Dimension

The world as we know it is made up of objects which exist in integer dimensions, single dimensional points, one dimensional lines and curves, two dimension plane figures like circles and squares, and three dimensional solid objects such as spheres and cubes. This concept of dimension can be described both intuitively and mathematically. Intuitively we say that a line is one dimensional because it only takes one number to uniquely define any point on it. That one number could be the distance from the start of the line. This applies equally well to the circumference of a circle, a curve, or the boundary of any object. A plane is two dimensional since in order to uniquely define any point on its surface we require two numbers. There are many ways to arrange the definition of these two numbers but we normally create an orthogonal coordinate system. Other examples of two dimensional objects are the surface of a sphere or an arbitrary twisted plane. The volume of some solid object is three dimensional on the same basis as above, it takes three numbers to uniquely define any point within the object.

However, many things in nature are described better with dimension being part of the way between two whole numbers. Mandelbrot coined the word fractal to describe a dimension that could not be expressed as an integer. One of the unique things about fractals is that they have non-integer dimensions. That is, while we are in the third dimension, looking at this on a flat screen which can be considered more or less the second dimension; fractals are in between the dimensions. Fractals can have a dimension of 1.8, or 4.12.[12] Although fractals may not be in integer dimensions, they always have a smaller dimension than what they are on. While a straight line has a dimension of exactly one, a fractal curve will have a dimension between one and two, depending on how much space it takes up as it curves and twists. The more a fractal fills up a plane, the closer it approaches two dimensions. In the same manner of thinking, a *wavy* fractal scene will cover a dimension somewhere between two and three. Hence, a fractal landscape which consists of a hill covered with

[12] Lesmoir-Gordon, Nigel, Will Rood and Ralph Edney (ed.), *Introducing Fractal Geometry*, 20.

tiny bumps would be closer to two dimensions, while a landscape composed of a rough surface with many average sized hills would be much closer to the third dimension.

A more mathematical description of dimension is based on how the "size" of an object behaves as the linear dimension increases. In one dimension consider a line segment. If the linear dimension of the line segment is doubled then obviously the length (characteristic size) of the line has doubled. In two dimensions, the linear dimensions of a rectangle for example are doubled then the characteristic size, the area, increases by a factor of 4. In three dimensions if the linear dimension of a box are doubled then the volume increases by a factor of 8. This relationship between dimension D, linear scaling L and the resulting increase in size S can be generalized and written as $S= L^{D}$.[13] This is just telling us mathematically what we know from everyday experience. If we scale a two dimensional object for example then the area increases by the square of the scaling. If we scale a three dimensional object the volume increases by the cube of the scale factor. Rearranging the above gives an expression for dimension depending on how the size changes as a function of linear scaling, namely D= Log S/ Log L

The equation reveals that there are many shapes which do not conform to the integer based idea of dimension given above in both the intuitive and mathematical descriptions. That is, there are objects which appear to be curves for example but which a point on the curve cannot be uniquely described with just one number. If the earlier scaling formulation for dimension is applied the formula does not yield an integer. There are shapes that lie in a plane but if they are linearly scaled by a factor L, the area does not increase by L squared but by some non integer amount. The following are the examples of fractals.

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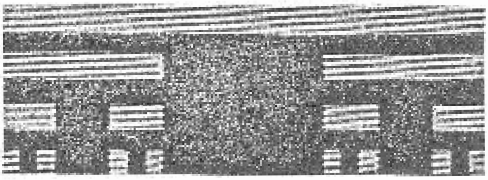
[13] Cf. *Fractals* in http://www.bugman123.com/Fractals/Fractals.html, accessed on 18-04-2010.

06. Cantor Set

The Cantor set is a good example of an elementary fractal. The set is generated by the iteration on a line of unit length as follows:



The set is generated by the iteration on a line of unit length. With each iteration, the middle third from each line segment of the previous set is simply removed. As the number of iterations increases, the number of separate line segments tends to infinity while the length of each segment approaches zero. Under magnification, its structure is self-similar. Its magnification factor is three, and the line segments decompose into two smaller units.

D = Log 2/Log 3 = 0.6931/ 1.0986

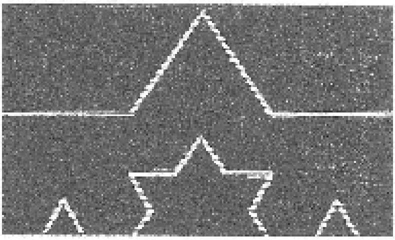
D= 0.6309

07. Koch's Curve

Fractals and fractal dimensions can also be defined by adding onto geometric figures. The Koch Curve which is named after Helge von Koch in 1904 is another example of fractals. [14] The generation of these fractals is simple. We begin with a straight line of unit length and divide it into three equally sized parts. The middle session is replaced with an equilateral triangle and its base is removed. After each iteration, the length is increased by four-thirds. As this process is repeated, the length of the figure tends to infinity as the length of the side of each new triangle goes to zero. Assuming this could be iterated an infinite number of times; the result would be a figure which is infinitely wiggly, having no straight lines whatsoever. To calculate the dimension of the Koch Curve, we look at the image of

14 Cf. *Fractals* in http://www.bugman123.com/Fractals/Fractals.html, accessed on 18-01-2010

the fractal and realize that it has a magnification factor of three and with each iteration; it is divided into four smaller pieces. Knowing this we get


The Koch Curve has a dimension of 1.2619.

D = log 4/log 3

D = 1.3863/1.0986

D = 1.2619

08. Difference between Fractals and Geometry

First the recognition of fractal is very modern; they have only formally been studied in the last 10 years compared to Euclidean geometry which goes back over 2000 years. Secondly whereas Euclidean shapes normally have a few characteristic sizes or length scales (e.g.: the radius of a circle or the length of a side of a cube) fractals have so characteristic sizes. Fractal shapes are self similar and independent of size or scaling. Third, Euclidean geometry provides a good description of man made objects whereas fractals are required for a representation of naturally occurring geometries. It is likely that this limitation of our traditional language of shape is responsible for the striking difference between mass produced objects and natural shapes. Finally, Euclidean geometries are defined by algebraic formulae; on the other hand fractals are normally the result of a iterative or recursive construction or algorithm.

09. Uses of Fractals

Artists have created very realistic looking landscapes composed of just a few fractal equations. Fractals also have technological applications.[15] Antennas have always been a tricky subject. Many antenna engineers

[15] *Fractals: An Introductory Lesson* in http:/www.arcytech.org/java/fractals, accessed on 20-04-2010.

have been reduced to using trial and error because of the complex nature of electromagnetism. Antenna arrays consist of thousands of small antennas which are either placed randomly or regularly spaced. For an antenna to work equally well at all frequencies, it must be symmetrical around a point and it must be self-similar, both of which fractals can provide. Fractals provide the perfect mix between randomness and order, and with fewer components. Parts of fractals have the disorder, while the fractal as a whole provides the order. By bending wires into the shape of Koch's Curve, more wire can be fit into less space, and the jagged shape also generates electrical capacitance and inductance. This eliminates the need for external components to tune the antenna or to broaden its range of frequencies. Motorola has started using fractal antennas in many of its cellular phones, and reports that they're 25% more efficient than the traditional piece of wire. They are also cheaper to manufacture, can operate on multiple bands, and can be put into the body of the phone. Fractal model may provide useful approximations of reality over a finite range of scales. Mandelbrot and others have applied fractals as explanatory models of natural phenomena involving irregularities on different size scales. This technique is used in graphical analysis in such diverse fields as fluid mechanics, economics, and linguistics and in the study of crystal formation, vascular networks in biological tissue, and population growth.

One of the most useful applications of fractals and fractal geometry is image compression. It is also one of the more controversial ideas. The basic concept behind fractal image compression is to take an image and express it as iterated system of functions. The image can be quickly displayed, and at any magnification with infinite level of fractal detail. The largest problem behind this idea is deriving the system of functions which describe an image. Another more trivial application of fractals is their visual effect. Fractals have been used commercially in the film industry as an alternative to costly elaborate sets to produce fantasy landscapes. Both fractals and chaos is used in music too. Some music can be stripped down so that it contains as little as $1/64^{th}$ of its notes and still remain the essence of the composer. Fractal geometry also has an application in biological analysis. Fractals and chaos phenomena specific to non-linear systems are widely observed in biological systems. A study has established an analytical method based on fractals and chaos theory for two patterns: the dendrite pattern of cells during development in the cerebellum and the firing pattern of intercellular potential. Variation in the development of the dendrite stage was evaluated with fractal dimension.

10. Fractals as the Geometry of the Universe

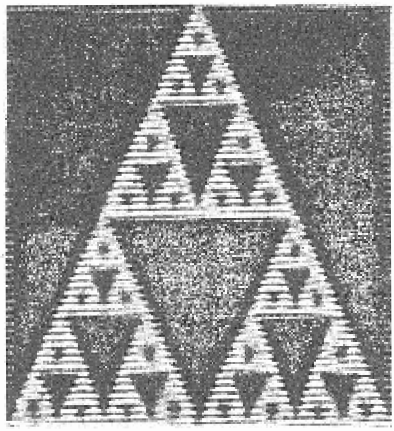
Fractals are the Geometry of the Universe. Most natural processes are chaotic systems. For example the sea is a chaotic system driven by a finite amount of inputs - wind, sun, tides, landmasses, etc. The result is a chaotic system which although possible to predict generally is hard to predict in detail. Changes in s chaotic system can have different levels of impact. Each event has a constantly different amount of effect on the next step. The famous example is the 'butterfly effect' coined by Edward Lorence.[16] He says that the flapping of the wings of a butterfly can, at a given time, effect the direction of a hurricane on the other side of the planet. Or it may have no effect at all. It is this apparent lack of ease of prediction that creates what we call the random effects. A chaotic system can only be predicted if all the inputs into the system are known and all the rules of the system are known. Chaos theory is about patterns in chaos and chaos in pattern. Because a chaotic system is about repeated steps often-irregular patterns or sometimes almost regular patterns are produced. The theory of Chaos is about explaining apparent disorder and order in the universe.[17] It states that things are random and complex and order emerges out of disorder. The chaos refers to an underlying interconnectedness that exists in apparently random events. The repetitive and self-similar features of fractal geometry substantiate the theory of chaos. Based on the chaos theory and fractal geometry

16 *Fractals: An Introductory Lesson* 47,50.

17 Kuruvilla Pandikkattu, *The Bliss of Being Human*, 53.

we may come to the conclusion that roughness is very much in the nature of the universe from the very beginning. The uncertainties and contingencies are part and parcel of the cosmic process. They are the diverse steps of the cosmic dance. Thus the fractalian worldview can accommodate every natural process, every phenomenon and every roughness.

11. Mystical Nature of Fractals: Infinite within the Finite



The Sierpinski triangle explains the infiniteness of fractals. It shows how the concept of infinite can be traced within the finite. The Sierpinski triangle is created by infinite removals. Each triangle is divided into four smaller, upside down triangles. The centre of the four triangles is removed. On an infinite number of iteration, the total area of the set tends to infinity as the size of each new triangle goes to zero. The concept of infinite can be metaphorically viewed as the mystical dimension of the fractal structure of material reality.

12. Mysticism as a Platform for Science -Religion Interfacing

The mystical orientation provided by fractals in science calls for an authentic understanding of mysticism in religion. Science and religion play a significant role in exploring the mysteries of the universe including roughness in nature and life. But we have to understand the uniqueness of each discipline that each tries to explain the reality in its own way. Science tries to analyse the mysteries of the universe concretely and objectively. But the objectivity and concretisation lead to a transcendental realm of 'infinity' which is beyond objectivity. In a similar fashion religion tries to respond to the reality in a subjective way and ultimately that too reaches the transcendental realm. The search of science and religion though started from different directions, finally reach into as common transcendental realm. This common realm can accommodate the roughness and mysteries of our life. It does not call for a mixing up of faith language and scientific language but a constructive interface between faith and reason based on a criterion of reasonableness. It also calls for the possibility of drawing analogical and metaphorical parallels from science to enhance one's religious consciousness.

Basically the difference between faith language and scientific language lie in the approach. A religious and a scientist approach the reality differently.[18] The apparent contradictions between science and religion are only complementary. The common factor between science and religion is their search for truth.[19] The reality which each seeks after is the same but attitude of observation and understanding are different between the scientist and the religious. Science seeks knowledge but the religious quest is for wisdom. Knowledge and wisdom are neither coextensive nor mutually exclusive. But they overlap, in this sense, science and religion are like different sorts of maps, and both help us to get around in the world because each in its own way represents that world/reality more or less faithfully. Science and religion are two sides of reality and they complement each other.[20] Science describes the reality of existence whereas religion inspires the meaning of its existence. Hence science and religion together make the meaning of reality understandable. Both being complementary to each other, gives us the comprehensive view and understanding of the reality. The opposition between science and religion is often a struggle to clarify, to what extent causal explanations are compatible with real meaning and actual reality.[21]

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18 Cf. Francis P. Xavier S.J., *God of the Atoms*, LIFE/ISPCK, 2006, 3.

19 Francis P. Xavier S.J., *God of the Atoms*, 3.

20 Francis P. Xavier S.J., *God of the Atoms*, 42.

21 Francis P. Xavier S.J., *God of the Atoms*, 6.

13. Fractals and Challenges in Life

We are fortunate to live in a three dimensional world of space. The length, breadth and height constitute the space around us and make up the reality we live in. It is marvellous to experience the depth of space that is possible only in a three dimensional world. However, it is plausible for us to imagine dimensions that are more than three. The special theory of relativity has brought to light the fourth dimension in the form of space. Some versions of the super string theory in physics assume that reality has eleven dimensions (M-theory). They assume that right at the beginning of the universe all these dimensions were active. Later they folded themselves up and so at present we can perceive only three dimensions. The fractal geometry has introduced another type of dimension to material reality entirely different from the traditional understanding which is both finite and infinite, fractal dimensional and multi-dimensional. The philosophical and religious challenges posed by multi-dimensional understanding of reality are tremendous. What would life after death look like in a multi-dimensional world? Is it a continuation of our space-time existence or a dimensionally different mode of existence? What would be our understanding of God in a multi-dimensional world?

The questions on multi-dimensionality do challenge the way we live our spiritual and religious life. So the possibility of new discoveries by scientists must excite us. At the same time, we must remember that we have not exhausted the mystery and complexity of the material reality. Though physics can legitimately seek such answers, the metaphysical and religious challenges cannot be ignored. It calls for the re-formulation of religious terminologies and re-interpretation of the traditional religious worldview. The role of philosophy and theology is to mediate the two tensional aspects of life: that of the material and the beyond. Being aware of the mystical nuances of science, both these disciplines must make use of the scientific explorations to make rational sense of the ambiguous and fascinating aspects of ourselves and of the reality.

14. Conclusion

The fractal geometry tries to analyse the mysteries of the universe concretely and objectively. As seen above the objectivity leads to a subjective and transcendental realm of mystery, which is beyond objectivity. This transcendental realm can accommodate the roughness and mysteries of our life. In this sense all of us are called to become mystics. A genuine person will discover the sacred in various dimensions of life within and beyond oneself.[77] A mystic is free from anthropocentrism, cosmocentrism and theocentrism. There is no distinction between the self and the other, person and nature, divine and human. In a mystical state every thing is realized as it is. There is no dominant - subordinate relationship and no subject - object relationship. Everything is dominant over everything else and at the same time every thing is subordinate to every thing else. There is interpenetration and mutual reversibility in mysticism including all the opposites. It is a synthesis of opposites: Infinite yet closer, intangible even though experiential, present even when we experience its absence and transcendence in immanence. It is a sense of mysticism to that which is beyond the self, beyond science and beyond religion, yet approachable.

In this article we have made an enquiry into the mystical dimension of science with respect to contemporary developments in astrophysics. The historical synthesis of the mystical roots of science has shown how science lost its mystical nature, especially in the modern era, corresponding to the emergence of the dualistic world-view in philosophy. However contemporary science, very specially the fractal geometry has taken us to a mystical realm which blurs the dichotomised world-views in philosophy and science.

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[77] Cf. Siji Noorokariyil, *Children of the Rainbow – An Integral Vision and Spirituality for Our Wounded Planet*, media House, Delhi, 2007, 107-10.

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1. The manuscript should be of an average length of 6,000 words, neatly typed in double space, on A-4 size papers, on single side. It should be submitted in duplicate and the first page should carry only the title of the paper, author[s]' name[s], designations, official address, phone/fax numbers and e-mail addresses. A separate biographical sketch of the author[s] with passport size photograph[s] should be enclosed.
2. Each manuscript should carry on abstract of about 150-200 words.
3. The tables and figures in the text should be centralised.
4. Endnotes: All notes should be indicated by serial numbers in the text and the detailed references should be given as endnotes at the end of the paper, following the corresponding numbers before the references and explanations. No footnote system is to be followed.
5. References: The list of references should be placed after the endnotes, and arranged in the alphabetical order, on the basis of the surnames. Only the works cited or referred to in the main text should be cited under the references. Follow the structure of: Author's name, title of the work, place of publication, publishers, years.

   Eg: Kaplan, H.I., Sadock, B.J., & Grebb, J.A., Synopsis of Psychiatry, 7th Ed., New Delhi: B.I. Waverly Pvt. Ltd., 1994.

   In case of more than one publication by the some author, arrange them in chronological order, with the earlier publication being mentioned first. If there is more than one publication in the same year, indicate them by adding lower case letters of the alphabet to the year. [eg: 1982a, 1982b].
6. British English spelling is to be used throughout the manuscript.
7. Double quotes should be used throughout. Single quotes should be used only for quotes within quotes.
8. Every contribution should be accompanied by a declaration that the article is original and has not been published nor submitted elsewhere for publication.
9. Every accepted article will be copy-edited. The editorial board reserves the right to make necessary revisions to the text.
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11. Every author will receive 10 offprints, and one complimentary copy of the issue in which one's paper appears.
12. Book reviews shall be of around 1000 words, and should carry the following details in the order as below: Name of the author, title of the book reviewed, place of publication, name of the publisher, year of publication, number of pages in Roman and Arabic figures to include preliminary pages, and price, with binding specifications as to whether it is paperback or hardcover.
13. Comments shall be of an average length of 1500 words.
14. The author should send a soft copy on a CD [in MS Word] containing the full paper, along with the hard copies. It is necessary that the contents of the CD and the hard copy should be absolutely the same.
15. Manuscripts and all editorial correspondence should be addressed to:

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