UNIT 4 RELATIONALITY: RECENT SCIENTIFIC DISCOVERIES

Contents

4.0 OBJECTIVES

- To explore some of the recent scientific basis for relationality.
- To appreciate that relationality is fundamental to the universe, even at the physical level.

4.1 INTRODUCTION

Today science has profoundly shaped and changed the understanding of reality and of ourselves. In this unit, we wish to study the intimately, relational understanding of reality and human beings as espoused by contemporary science. Such an understanding will have profound implications for the understanding of humans themselves. In the first part of this unit, we use the ordinary alphabets to indicate that language and reality is more than monadic letters. Then we take up three scientific theories to indicate the inherent connectedness of the whole reality. we also use another contemporary scientific finding to show us that we do not perceive much of the empirical world, urging us to be humble in our approach to the larger world. Then in the light of our scientific analysis, we recognize human beings not as a pure entity but as an evolving horizon that is ever becoming. Finally we dwell briefly on love and relationality which are constitutive of reality.

4.2 RELATIONSHIP AMONG ALPHABETS

Alphabets, or phonemic alphabets, are sets of letters, usually arranged in a fixed order, each of which represents one or more phonemes, both consonants and vowels, in the language they are used to write. In some cases combinations of letters are used to represent single phonemes, as in English sh, ch and th. (http://www.omniglot.com/writing/alphabets.htm). The word alphabet comes, via Latin *alphabetum*, from the Greek word *(alphabetos)*, which itself comes from the

first two letters of the Greek alphabet, α *(alpha)* and β *(beta)*. The best-known and most widely-used alphabets are the Latin or Roman alphabet and the Cyrillic alphabet, which have been adapted to write numerous languages. Most other alphabets are used for a single language or just a few languages.

The history of the alphabet begins in Ancient Egypt, more than a millennium into the history of writing. (http://en.wikipedia.org/wiki/Alphabet) The first pure alphabet emerged around 2000 BC to represent the language of Semitic workers in Egypt and was derived from the alphabetic principles of the Egyptian hieroglyphs. Most alphabets in the world today either descend directly from this development, for example the Greek and Latin alphabets, or were inspired by its design. The Greeks were the first people to create a phonemic alphabet when they adapted the Phoenician alphabet to write their language. They used a number of Phoenician letters that represented sounds with no equivalent in Greek to write Greek vowels.

Looking at the structure of written English language, we can describe it as being made up of building blocks called words. Words, when they are written down, are made up sequences or *strings* of the 26 letters in the alphabet. Not every sequence or string of letters that we put together forms a word that we recognize or *accept* as part of the English language. (http://www.c3.lanl.gov/mega-math/workbk/machine/mabkgd.html)

Similar to English, languages that are made of "words" which are "strings" of "letters" from an "alphabet" are found in many areas of science. Biologists, for example, know that proteins are made up of discrete building blocks called amino acids that can only occur in certain combinations. A DNA molecule is a long chain made up of only four building blocks, but the patterns and ordering of the elements of this alphabet is used to write out the "words" that describe the genetic material of all living things.

After experimenting with the letters of the alphabet, it will become evident that for any *finite* set of letters or symbols of the *alphabet,* the number of *words may be* infinite. Thus obviously alphabets are important in forming words. But on their own they are useless and insignificant. Only in creative combination and guided sequence do they make sense. What is noteworthy is the location of space between words. Unlike zero in number system, space does not have any value in itself. But it is the space that contributes to the construction of a meaningful word. Though the number of possible combination and permutation of the letters can be infinite, for any useful purpose to serve, they have to be located properly and bound suitably. So the space between words does have a function which is different from zero, but necessary for the meaning construction.

The use of alphabets to describe words denotes the importance of positioning or placement in the derivation of meaning. So in using alphabets to write words, positioning, sequencing and recognition pattern emerge as very highly significant. After focusing on the positioning and patterns that constitute meaning and life, we take up a few important scientific theories that demonstrates that reality is much more than the empirical or quantifiable aspect of physical experience.

Check Your Progress I

Note: Use the space provided for your answer

1) What is the significance of positioning in alphabets?

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2) Where did the first alphabets emerge?

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4.3 SOME SCIENTIFIC POINTERS TO RELATIONALITY

In this section we take up a few of the contemporary scientific theories that point to the inherently relational and connected nature of reality. Due to lack of space we are forced to give only a general overview of some of the significant theories in contemporary science. In the following sections, we shall see the salient insights of relativity theory and chaos theory which help us to understand how the whole of reality be intimately coupled.

Relativity Theory: The Field Theory

Newtonian mechanics provided the paradigm to understand the classical physical world. According to Isaac Newton, material objects basically pull on each other, with a force that increases with the mass of those objects; and decreases with the distance between them. His solution relating mass, force, energy and acceleration, was elegant and accurate. Though, Newton, himself, was not satisfied because he saw no way for this force to be conveyed through empty space. Thus in spite of the mind-boggling and fantastic achievements, Newton laments: "I have not as yet been able to deduce from phenomena the reason for these properties of gravity, and I do not feign hypothesis. For whatever is not deduced from the phenomena must be called hypothesis; and hypotheses, whether metaphysical or physical, or based on occult qualities, or mechanical, have no place in experimental philosophy."(Isaac Newton *The Principia.* Cited in http://anson.ucdavis.edu/~beran/inference.html.) In sharp contrast to Newton's theory, Einstein proposed that the *structure* (or geometry) of space was responsible for gravity, In fact, this greatest scientific genius seldom saw no need for material objects as he affirmed: "We could regard matter as the regions in space where the field is extremely strong.... There would be no place, in our new physics, for both field and matter, field being the only reality." (http://www.gravityandspace.com/Gravity_Potent.html)

Although matter is generally conceived to be made of atoms, the actual volume of atomic (or sub-atomic) particles in a material object is only about one-trillionth of the total volume of that object. The rest of the volume is occupied by relational space. So almost all the volume of matter is actually space. And within that space, there lies electric and magnetic fields that somehow serve to hold matter together. Einstein's General Theory of Relativity did away with many of the classical problems of physics, and at the same time it radically altered physicists' view of the Universe. The main features of General Relativity may be summed up as:

- Space and space-time are not rigid arenas in which events take place. They have form and structure which are influenced by the matter and energy content of the universe.
- Matter and energy tell space (and space-time) how to curve.
- Space tells matter how to move. In particular, small objects travel along the straightest possible lines in curved space (space-time). (John Wheeler, http://theory.uwinnipeg.ca/mod_tech/node60.html.)

In curved space the rules of Euclidean geometry are changed. Parallel lines can meet and the sum of the angles in a triangle can be more, or less than 180 degrees, depending on how space is curved. Einstein's theory gave a correct prediction for the perihelion shift of Mercury. It also explained why objects fall independent of their mass: they all follow the same straightest possible line in curved space-time. Finally, in Einstein's theory the instantaneous gravitational force is replaced by the curvature of space-time. Moving a mass causes ripples to form in this curvature, and these ripples travel with the same speed as light. Thus, a distant mass would not feel any instantaneous change in the gravitational force, and special relativity is not violated. (http://theory.uwinnipeg.ca/mod_tech/node60.html). According to Albert Einstein, "The electric and magnetic field or in short, the "electromagnetic" field is, in Maxwell's theory, something real." (Albert Einstein & Leopold Infeld, *The Evolution of Physics: From Early Concepts to Relativity and Quanta,* A Touchstone Book, Simon & Schuster, New York, p. 145.)

Chaos Theory: The Butterfly Effect

The Theory of chaos is among the youngest of the sciences, and has rocketed from its obscure roots in the seventies to become one of the most fascinating fields in existence. At the forefront of much research on physical systems, and already being implemented in fields covering as diverse matter as arrhythmic pacemakers, image compression, and fluid dynamics, chaos science promises to continue to yield absorbing scientific information which may shape the face of science in the future. This theory deals with non-linear and complex situations like stock-market, flow of blood in the human body, weather forecast, etc.

The two main components of chaos theory are the ideas that systems – no matter how complex they may be – rely upon an underlying order and that very simple or small systems and events can cause very complex behaviors or events. This latter idea is known as *sensitive dependence on initial conditions*, a circumstance discovered by Edward Lorenz (who is generally credited as the first experimenter in the area of chaos) in the early 1960s. Taking only the second aspect of the theory, I want to limit my investigation to the butterfly effect, which theories that

something seemingly innocuous, such as a butterfly's wings, may be the catalyst for something larger, such as a tornado. The *butterfly effect* is a phrase that encapsulates the more technical notion of *sensitive dependence on initial conditions* in chaos theory. (Wikipedia) The small variations of the initial condition of a nonlinear dynamical system may produce large variations in the long term behavior of the system. At times this is sometimes presented as esoteric behavior, but can be exhibited by very simple systems: for example, a ball placed at the crest of a hill might roll into any of several valleys depending on slight differences in initial position.

The phrase refers to the idea that a butterfly's wings might create tiny changes in the atmosphere that ultimately cause a tornado to appear (or prevent a tornado from appearing). The flapping wing represents a small change in the initial condition of the system, which causes a chain of events leading to the large-scale phenomena. Had the butterfly not flapped its wings, the trajectory of the system might have been vastly different. (Wikipedia) Recurrence, the approximate return of a system is towards its initial conditions; together with sensitive dependence on initial conditions are the two main ingredients for chaotic motion. They have the practical consequence of making complex systems, such as the weather, difficult to predict past a certain time range (approximately a week in the case of weather). (Wikipedia)

Sensitive dependence on initial conditions was first described by Jacques Hadamard in 1890 and popularized by Pierre Duhem's 1906 book. (Pierre Duhem (1861–1916) was a French physicist and philosopher of science. As a physicist, he championed "energetics," holding generalized thermodynamics as foundational for physical theory, that is, thinking that all of chemistry and physics, including mechanics, electricity, and magnetism, should be derivable from thermodynamic first principles. The book referred is *La théorie physique, son objet et sa structure*, Paris, Chevalier et Rivière, 1906.) The idea that one butterfly could have a far-reaching ripple effect on subsequent events seems first to have appeared in a 1952 short story by Ray Bradbury about time travel, although the term "butterfly effect" itself is related to the work of Edward Lorenz. In 1961, Lorenz was using a numerical computer model to rerun a weather prediction, when, as a shortcut on a number in the sequence, he entered the decimal .506 instead of entering the full .506127 the computer would hold. The result was a completely different weather scenario. Lorenz published his findings in a 1963 paper for the New York Academy of Sciences in which it was noted that "One meteorologist remarked that if the theory were correct, one flap of a seagull's wings could change the course of weather forever." Later speeches and papers by Lorenz used the more poetic butterfly. According to Lorenz, upon failing to provide a title for a talk he was to present at the 139th meeting of the American Association for the Advancement of Science in 1972, Philip Merilees concocted *Does the flap of a butterfly's wings in Brazil set off a tornado in Texas* as a title. (Wikipedia) From then on butterfly effect has become a popularly successful theory.

So there are in reality many natural phenomenon which are so extremely sensitive to the initial conditions, that the outcome –intended or unintended – cannot be theoretically predicted. In such a world, one can visualize that the relationship between events or between individuals are so complex that we cannot sensibly speak of determinism and cause-effect. Thus in such areas what we have are not accurate measurements but rough approximations. And a major aspect of reality

is thus approximation, which belong to the world of roughness and inter-relationships.

4.4 THE UNKNOWN UNIVERSE

The cosmic reality that we experience is truly and ontologically connected and interrelated. At the same time there is another significant fact that the physicists tell us out of experimental observation, which the mystics of all religious tradition have always implied. It is about how little we really know about the reality, which truly makes us humble and open-minded. So in this section we shall briefly deal with two of the most puzzling phenomena that confront today's astrophysicists: that of dark matter and dark energy.

Dark Matter

In 1933, the astronomer Fritz Zwicky was studying the motions of distant galaxies. Zwicky estimated the total mass of a group of galaxies by measuring their brightness. When he used a different method to compute the mass of the same cluster of galaxies, he came up with a number that was 400 times his original estimate. This discrepancy in the observed and computed masses is now known as "the missing mass problem." Nobody did much with Zwicky's finding until the 1970's, when scientists began to realize that only large amounts of hidden mass could explain many of their observations. Scientists also realize that the existence of some unseen mass would also support theories regarding the structure of the universe. Today, scientists are searching for the mysterious dark matter not only to explain the gravitational motions of galaxies, but also to validate current theories about the origin and the fate of the universe. (Chris Miller, "Cosmic Hide and Seek: the Search for the Missing Mass," accessed at http://www.eclipse.net/~cmmiller/DM/ on 23 June, 2007.)

Scientists estimate that 90 to 99 percent of the total mass of the universe is the dark matter. Scientists can tell that the dark matter is there, but they cannot see it. Bruce H. Margon, chairman of the astronomy department at the University of Washington, told the *New York Times*, "It's a fairly embarrassing situation to admit that we can't find 90 percent of the universe." (Wilford, John Noble. "Astronomy Crisis Deepens As the Hubble Telescope Finds No Missing Mass." *New York Times*. 29 Nov. 1994: C1-C13). This problem has scientists scrambling to try and find where and what this dark matter is. "What it is, is any body's guess," adds Dr. Margon. "Mother Nature is having a double laugh. She's hidden most of the matter in the universe, and hidden it in a form that can't be seen" (McDonald, Kim A. "New Findings Deepen the Mystery of the Universe's 'Missing Mass'." *Chronicle of Higher Education*. 23 Nov.1994: A8-A13)

What do scientists look for when they search for dark matter? We cannot see or touch it: its existence is implied. Possibilities for dark matter range from tiny subatomic particles weighing 100,000 times less than an electron to black holes with masses millions of times that of the sun. The two main categories that scientists consider as possible candidates for dark matter have been dubbed MACHOs (Massive Astrophysical Compact Halo Objects), and WIMPs (Weakly Interacting Massive Particles). Although these acronyms are amusing, they can help you remember which is which. MACHOs are the big, strong dark matter objects ranging in size from small stars to super massive black holes. MACHOs

are made of 'ordinary' matter, which is called *baryonic* matter. WIMPs, on the other hand, are the little weak subatomic dark matter candidates, which are thought to be made of stuff other than ordinary matter, called *non-baryonic* matter. Astronomers search for MACHOs and particle physicists look for WIMPs.

Astronomers and particle physicists disagree about what they think dark matter is. Walter Stockwell, of the dark matter team at the Center for Particle Astrophysics at U.C. Berkeley, describes this difference. "The nature of what we find to be the dark matter will have a great effect on particle physics and astronomy. The controversy starts when people made theories of what this matter could be – and the first split is between ordinary baryonic matter and non-baryonic matter." Since MACHOs are too far away and WIMPs are too small to be seen, astronomers and particle physicists have devised ways of trying to infer their existence. (www.eclipse.net/~cmmiller/DM/)

Dark Energy

Dark energy started its long history in 1917 and was introduced by Albert Einstein. A constant (which he called Lamda) was needed in his equations of General Relativity in order to allow for a static Universe. But shortly thereafter, when Hubble made his famous discovery of the expansion of the Universe, this constant Lamda, now seeming an unnatural and superfluous admixture, was rejected, even by Einstein himself (although his often cited "biggest blunder in my life" most probably is a myth).

Later, when quantum theory was developed, it was realized that "empty space" was full of temporary ("virtual") particles continually forming and destroying themselves. Physicists began to suspect that indeed the vacuum ought to have a dark form of energy, and that Einstein's Lamda could be interpreted as vacuum energy. But when they tried to estimate its value, they disagreed with observational limits by 120 orders of magnitude, making this the most erroneous estimate in physics ever. Lamda was forgotten by most astronomers for nearly 70 years. Most interestingly, Lamda was unearthed in the 1990s in order to reconcile theory with observations. Nowadays it has become fashionable to call Lamda "dark energy." (http://www.astro.uni-bonn.de/~webiaef/outreach/posters/darkenergy/)

The discovery in 1998 that the Universe is actually speeding up its expansion was a total shock to astronomers. It just seems so counter-intuitive, so against common sense. But the evidence has become convincing. The evidence came from studying distant type Ia- supernovae. This type of supernova results from a white dwarf star in binary system. Matter transfers from the normal star to the white dwarf until the white dwarf attains a critical mass (the Chandrasekhar limit) and undergoes a thermonuclear explosion. Because all white dwarfs achieve the same mass before exploding, they all achieve the same luminosity and can be used by astronomers as "standard candles." Thus by observing their apparent brightness, astronomers can determine their distance using a simple mathematical calculation.

Astronomers know dark matter is there by its gravitational effect on the matter that we see and there are ideas about the kinds of particles it must be made of. By contrast, dark energy remains a complete mystery. The name "dark energy" refers to the fact that some kind of "stuff" must fill the vast reaches of mostly empty space in the Universe in order to be able to make space accelerate in its expansion.

In this sense, it is a "field" just like an electric field or a magnetic field, both of which are produced by electromagnetic energy. But this analogy can only be taken so far because we can readily observe electromagnetic energy via the particle that carries it, the photon. (imagine.gsfc.nasa.gov/docs/science/mysteries_l1/dark_energy.html)

In the context of dark energy, the cosmological constant is a reservoir which stores energy. Its energy scales as the universe expands. As yet, no scientist can give the answer to this fundamental question. We do not know what the nature of dark energy is, and unveiling this mystery will most probably reveal new physics and even might shake modern particle physics to its very foundations. Nevertheless, we have considerable astronomical knowledge about the properties of dark energy:

- Dark energy acts as a repulsive force or anti-gravitation. It is responsible for the acceleration of the Universe today.
- Dark energy is probably related to a vacuum energy density:(www.astro.uni-bonn.de/~webiaef/outreach/posters/darkenergy/)

Saul Perlmutter, leader of the Supernova Cosmology Project headquartered at Berkeley Lab remarked wryly. "The universe is made mostly of dark matter and dark energy, and we don't know what either of them is." (www.lbl.gov/Science-Articles/Archive/dark-energy.html) More recent precision observations have shown that on the one hand the Universe is spatially flat, but that on the other hand matter (both ordinary and dark matter) contributes only about 30% of the matter/energy density required for the Universe to be flat. The startling conclusion is that the dominant component (70%) of the Universe is in the more exotic form of ``dark energy." (ww.astro.uni-bonn.de/~webiaef/outreach/posters/darkmatter)

Thus the universe is not merely interconnected, we do not know even empirically what the universe is in fact made of. If 90-99% of the universe is unknown to the physicists, we need to be humble and accept the limitations of our human knowledge. It could be that this dark matter could further connect the reality more deeply.

Check Your Progress I

Note: Use the space provided for your answer

1) What percentage of the matter in the universe is dark matter?

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2) What is "butterfly effect"?

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4.5 BETWEEN BEFORE AND BEYOND

In the above section we have used the scientific theories to point to the inherent relational nature of the reality that includes the cosmos, humans and life. In this section I want to point to the essentially intentional or inherently dynamic nature of human being itself, who forms not a monad but a horizon that emerges and enlarges itself.

For this purpose we analyses the use of alphabets and language in our daily language. (Obviously language reflects the reality, the referred. But a brief reflection will tell us that language also reflects the human person, the speaker and its creator.) As we know prepositions are grammatical words that show relationships between two things. These relationships often relate to time or space. In grammar, an adposition is an element that combines syntactically with a phrase and indicates how that phrase should be interpreted in the surrounding context. If the location of a particular adposition is fixed with respect to its complement phrase, it may also be known as a preposition (comes before the phrase), postposition (after the phrase), or circumposition (around the phrase).

Adpositions form a heterogeneous class, with fuzzy boundaries that tend to overlap with other categories (like verbs, nouns, and adjectives). It is thus impossible to provide an absolute definition that picks out all and only the adpositions in every language. The following properties are, however, characteristic of the most frequently used, "core" members of most adpositional systems: The most common adpositions are single, monomorphemic words. According to the ranking cited above, for example, the most common English prepositions are *of*, *to*, *in*, *for*, *on*, *with*, *as*, *by*, *at*, *from*. Adpositions are among the most frequently occurring words in languages that have them. For example, one frequency ranking for English word forms begins as follows (adpositions in bold): *the*, *of*, *and*, *to*, *a*, *in*, *that*, *it*, *is*, *was*, *I*, *for*, *on*, *you*. (Wikipedia)

Our basic assumption is that noun denotes objects as entitities and verbs denotes objects in action. It is the appositions that denote the relationality between entities. Though such adpositions, and hence relationality, are the most frequently words in language, what is noteworthy is the very limited number of words denoting adpositions. Where as a normal dictionary may contain a large number of nouns and limited number verbs, the number of adpositions is less than 15. That could be one of the reasons why we have been traditionally identifying reality, including human beings, with individual objects. But in fact the human beings are materially composed of 'objects,' (nouns) and dynamically active (verbs) and the interrelationship that relates the nominal and the verbal forms of actions (adpositions). Understood thus, I am not the noun form "I" but the "between-ness" (now) that carries with itself the before (past) and the ever widening beyond (future or realization). That is why theologians feel comfortable to speak today not of human beings, but of human becoming. I am not the static being that forms a self-enclosed monad, but a dynamic becoming that is open to new possibilities.

Human beings are not just the "givenness" but have the opportunity and freedom to choose, realize, evolve and in the process the "gift" that makes out the given. Human being is therefore best characterized by the "horizon" that always recedes from us, but that always invites us and enlarges itself. The horizon, which

constitutes our dreams, visions, disappointments, hopes and aspirations and which includes our physical possibilities and limitations and the volitional yearning and openness is human being. In this sense, I am always one step ahead. I am a pilgrim reaching out to the highest and deepest and always on the way, but carried and supported by others. In this sense, each one of us is a relationship, intertwined and related to the whole of cosmic reality that is ever becoming.

4.6 LOVE AS RELATIONALITY

After having indicated the inherent relationality in reality, I want to make some brief reflection on the profound notion of love: its depth, significance and implication. We have seen from our above discussion that we need to go beyond the monadic (and the consequent dualistic) patterns of understanding reality and the human being. The traditional understanding of human being as a subject who interacts with other subject through love is not fully adequate in our world-view. The traditional understanding that love is a quality (or property) that the subject possesses need to be replaced by a more integral view. Such a view presupposes that love is integral to the subject or in other words it is love (relationship) together with the physical subject that constitutes the person. In this sense it is insightful that Christianity identifies God with love. Such an understanding is deeper than asserting that love is a property of God. Love, understood holistically, becomes the relationship of interdependence and mutual affirmation and is constitutive of reality.

In this sense a human person may be ontologically understood as love. A person is dependent on the environment, on the beloved ones and on the social setting, all of which are truly interacting, dynamic and inherently relational. A person himself or herself is also a relational entity in interaction with other persons. Finally we can hold that a person is truly in interaction with his or her own self. The self of a person evolves in contact interaction and feedback with oneself. The person is intrinsically dependent on relationship or interaction. Such an interaction when properly experienced, enhanced and affirmed could be interpreted as love, from a spiritual perspective. (Desbruslais 1998)

4.7 CONCLUSION

To recap some of our insights: counting and quantification has a value. But the significance of counting is derived from the pattern or sequence, as is abundantly clear from our use of alphabets in the language. In a similar vein we have shown from the scientific theories of the second part that pattern, configuration, interrelationships, fields, oscillations, tension and interconnectedness are constitutive of the totality of reality. So we need to go beyond a monadic or dualistic understanding of reality to a dynamic, connected and integral vision of reality which is ever evolving, like a horizon. The relativity theory speaks of the space-time curvature as a continuous, interacting field in exchange. The chaos theory with its butterfly effect points to the inherently instable state of both chaos and order and the intrinsic causal or non-causal relationship between the various entities in the universe. The string theory holds that it is oscillations or the vibration of the extended string, which can take different forms, that forms the basic building block of the universe. Such building blocks are essentially relational and interacting.

Still we need to admit with humility that about 90% of the reality is unknowable to contemporary physics. The dark matter and the dark energy present new mysteries to today's physics and affirm the need for the physicists to be humble and to carry forward their search in an open-ended manner. From such perspectives we can infer that essentially human beings are not merely entities or nodes, but "human becoming," or the between-ness, between before and beyond, which always tends to exceed itself and in the process creates itself ever new. We can also affirm that love, both metaphysically and affectively, is constitutive of such an interdependent reality. Thus from our study it is clear that the reality of the material cosmos is essentially relational. The self and the person that constitute the human becoming too are essentially in enriching interaction and enhancing connectedness. We are truly the dynamic, ever open between-ness – or better, in-between-ness - that goes beyond itself.

4.8 LET US SUM UP

After having seen the inherently relational aspect of the universe drawn from some scientific findings, we conclude this unit by asserting that love can be seen as one aspect of relationality.

Check Your Progress III

Note: Use the space provided for your answer

1) What is adposition?

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2) In the light of scientific and evolutionary findings today, how will you understand human beings?

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4.9 KEY WORDS

The *butterfly effect* **:** is a phrase that encapsulates the more technical notion of *sensitive dependence on initial conditions* in chaos theory. The small variations of the initial condition of a nonlinear dynamical system may produce large variations in the long term behavior of the system, like a flapping of a butterfly causing hurricane after many years in a far away place.

Chaos Theory : The Theory of chaos is among the youngest of the sciences, and has rocketed from its obscure roots in the seventies to become one of the most fascinating fields in existence. This theory deals with non-linear and complex situations like stock-market, flow of blood in the human body, weather forecast, etc.

Adposition : it is an element that combines syntactically with a phrase and indicates how that phrase should be interpreted in the surrounding context. If the location of a particular adposition is fixed with respect to its complement phrase, it may also be known as a preposition (comes before the phrase), postposition (after the phrase), or circumposition (around the phrase).

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