

Feynman, Penrose, Others and Vedānta

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Abstract

Most traditional Vedāntic practitioners dismiss science as a pursuit within duality, whereas Vedānta concerns itself with going beyond duality. Science is “lower” in this view point meant for earning a livelihood and enjoying life with no deep concern for the “higher”. Several distinguished and indisputably great scientists have very seriously dealt with questions that have bothered Indian “seers”. Their contributions are two fold: establishing the limits of extrapolation that most followers of religion and Vedanta perform very casually as well as invoking deep arguments from mathematics, cosmology, quantum mechanics and brain research on the possibility of establishing “consciousness” in the realm of “experience”, a subject that is the central theme of Vedāntic thought.

An influential lecture series by Swami Poornanada teertha in the early sixties, books by Paul Brunton, and Patanjali’s yoga sutras have been the foundation for the current exploration. The present article is based on a contemplative examination of scientific books by Richard Feynman and on him (by James Gleick), Roger Penrose, John D Barrow, Rothman and Sudarshan, and others. On the Vedāntic front, one of the very influential set of books (about half a dozen) is by Carlos Castaneda written after apprenticeship with a Mexican seer, Mattus Don Juan. Writings on life - both before and after the attainment of “Nirvana” - of those Indian seers whose life sketch is more accurately preserved, namely, Buddha, Ramana Maharshi, Chandrasekhara Bharati of Sringeri, and others including Sadāshiva Bramhendra, and Ādi Shankara, have been the basis for certain important deductions. The compellingly attractive lectures by Bhagawān Rajneesh (OSHO) written very authoritatively and other critical writings on the pursuit of Vedanta by J Krishnamurthy, U G Krishnamurthy, and others have also modulated the thinking set out here.

The article based largely on analytical reasoning with only minor undertone of personal experience. Based on the life sketches of seers and the way life is affected by applications of science to living by obtaining mastery over several of its aspects, a new paradigm is arrived at - *that the attainment of enlightened state is incomplete without the attainment of "Siddhis" and "Powers"*. It is appropriate to point out that almost all traditional practitioners of Vedanta dispute it based on the fact that it violates scriptural tradition, even though most people look for the presence of Siddhis in their wanderings looking for a powerful saint and perhaps, some personal gains.

Background

Early childhood of many people is conditioned by a dichotomous influence of religion and science. Attempt at adulthood rationalization through reading or listening to talks by saints, seers or philosophers still leaves a wide gap between religion and science. A study of some leading philosophers on the relationship between science and religion indicates to differing levels of perception till a point that one sets aside two mental compartments for the pursuit of these aspects of life and allow these subjects to be a part of armchair discussions occasionally. Compulsions of a fast and competitive living provides for setting aside certain fundamental questions till a point when these could hopefully become primary focus. Even this is postponed due to other societal demands. Further, authority and experience gained from the working life are used to provide for oneself and others instant rationalization, partly covered by quoting past masters and scriptures, with little insight.

There are just so many of these tribes that one rarely finds thinkers and practitioners with sufficient depth over an adequately large canvas to explore the new. One therefore needs to turn to writings by distinguished people of science who have thought it fit to explore fundamental questions and also examine the lives of saints and their recorded observations to evolve a consistent picture of the exploration of the truths of existence and related questions. The classical approach by practitioners of Vedāntic thought in established schools and Mutts is that what their spiritual master(s) has(have) indicated is the gospel truth and what all that can be done by others is to follow the tradition with deep faith, perhaps with no questioning. Any questioning can be patterned after what the original seers themselves have done and questioning beyond it could be blasphemous. Hence all the explorers of truth need to approach the established saints and seers with deep humility (or at least outwardly as thoroughly as possible) if they do not wish to be dismissed as human beings full of arrogance appropriate only for worldly work and not for spiritual matters.

Even if it is supposed that one wants to explore the truth through a careful study of the earlier work, there are at least two standards here. The writings by leading scientists on matters spiritual or close to that appear far more precise and insightful compared to writings on the lives of saints by adoring disciples (even here, western writers are far more careful than Indian writers). Considerable disservice is done to the exploration of truth by eulogizing and generalizing the stature of the saint by coloring the writing with a strong undeclared bias.

The areas of science that have significant impact in the exploration of the ultimate truth are quantum physics, cosmology and mathematics. The study of several other subjects like chemistry or biology involves molecular dynamics that depends on the structure of molecules reduced in detail to the atomic structure. This obviously relates their study to physics and when it comes to the exploration of atomic structure, it is the subject of quantum mechanics that is appropriate. When it comes to the question of existence of homo-sapiens on this planet in the scheme of the universe, cosmology, particularly the many advances in the last several decades will help to provide insight.

Science has tracked down the origin of the universe including the early evolution. It is known that the universe is about 13.7 billion years old; the pre-biotic age is 4.5 billion years; Microorganisms evolved around 3.5 billion years ago and the atmosphere of the earth that we have today was developed 1.5 billion years ago; Visible life forms evolved from this period till about 100 million years ago at which stage the first primates developed. The homo-sapiens, to which group we belong, evolved around 35,000 years ago (see The Web of life, Fritjof Capra). When we talk of civilization that has led to creation of Vedas we are talking about a period 5000 years ago. The Upanishadic period that is towards the end of development of Vedas; allowing for some overlap in the development of the different Vedas (Rig, Yajur, Sāma and Atharvana) it is about 2800 to 3200 years ago. Buddha lived 2500 years ago. Âdi Shankara lived about 1200 years ago. Taking this period as one of development and culmination of the process of understanding of questions on the truth about one-self, the inference is that this has occurred over the last three thousand years. The understanding due to revelations by a whole range of saints and seers, in the above period and later, was aimed at making the personal life of an individual to be contented with the limited possessions with serious advice “not to desire for more” and seeking peace of mind in life.

On the other hand, the critical developments of science relevant to the subject of this article are only a few hundred years old. The Cartesian world format of Newton got altered due to scientific developments in the last part of the nineteenth and the early part of twentieth centuries, the most celebrated of the scientists responsible for these being Albert Einstein whose contributions to aspects of gravity and universe are considered far more significant. The world of small - atomic scale or smaller - needed a description far different from the

Newtonian frame work; the most significant developments triggered by Planck and Einstein, but taken up by Niels Bohr, Schrödinger and others led to the development of quantum mechanics and later quantum electrodynamics whose influence on the technological interventions has been stupendous. Also it is in the last hundred years, the developments that have altered the perception of living on the planet are: transportation by flight within and outside the atmosphere, communication over large distances all over the planet, information technology support, apart from the advances in other aspects of living - medicine, health care and others. Rationally, it will be impossible to deny the overwhelming influence of science on the living pattern of all the civilizations over the planet all of it obtained because of the contributions to the understanding of nature provided by science.

If we review the corresponding developments in Vedānta or mysticism or religion, over the last several hundred years, it may said to be not on a comparable scale. More and more influential religious leaders have grown, many with some understanding and experience, generally *quoting the scriptures* and swearing that most knowledge of relevance was created over two thousand years ago and all that we need to do is to remind ourselves about it and practice it. Most discourses are on interpretations of Bhagavadgeeta, Raamaayana, Upanishads, Bhaagavata, and others with occasional constructions of parables and stories from current life, all of these aimed at reinforcing the principles expounded in these books. There have been many inconsistent statements (taken literally) and these pose no problems generally. Sanskrit words have multiple meanings and the scriptural writing is usually cryptic. Both these allow the interpreter to expound on the subject assuming his/her own freedom as an expert. There are conflicts between different interpretations and these pose no problem either. They allow lots of time for most interested listeners to discuss different interpretations with perhaps no distinct conclusion and advancement in understanding.

It is difficult to make any reasonable consistent progress in understanding with a confusing set of inputs from various sources with a strong emphasis on scriptural authority even though it appears that several men of distinction have held views on scriptures that are not identical, some not even close. One needs to seek a different class of authority - based on greater solidity in its foundation - to whatever extent that is feasible. One can do this with greater ease in science by reading how one set of distinguished people treat others and what consistency is evident in this process, in case one cannot judge the profundity of the scientist in question completely on once own, through a study of the writings or listening to the lectures. There are several scientists who have examined certain fundamental questions with care. We will now consider these scientists and the reasons for their choice.

Richard Feynman

Richard Feynman (RF, for short), an extraordinary scientist, exhibited a most colorful life as a scientist and a conscientious human being. His character and abilities are evident in his own statements and the writings of others. It is most appropriate to present the appreciation of Roger Penrose in the introduction to a collection of his lectures in a book entitled "Six not-so-easy pieces" - "Yet, in the popular conception of Feynman, he is known for his antics, buffoonery, for his practical jokes, his irreverence towards authority, his bongo-drum performing, his relations with women, both deep and shallow, his attendance at strip clubs, his attempts, later in life, to reach the obscure country of Tuva in central Asia, and many other schemes. Undoubtedly, he must have been extraordinarily clever, as his lightning quickness at calculation, his exploits involving safe cracking, outwitting security services, deciphering Ancient Mayan texts - not to mention his eventual Nobel Prize - clearly demonstrate. Yet none of this quite conveys the status that he unquestionably has amongst physicists and other scientists, *as one of the deepest and most original thinkers of this century* (bold italics mine)....He was beholden to no one, and would never take on trust what others might maintain to be true without himself coming to an independent judgment. Accordingly, his approach was often strikingly original whether in his research or teaching. And when Feynman's way differed significantly from what had gone before, it would be a reasonably sure bet that Feynman's approach would be the more fruitful one to follow."

James Gleick in his well researched, outstandingly written book "Genius" presents a picture of Feynman that is fabulously rich in details. Discussing the fact that Feynman belonged to the same tribe as Einstein, Bohr and Dirac in terms of being a genius, he quotes a colleague of Feynman, Sidney Coleman "When he (Feynman) was doing work he was doing it in a way that was just - absolutely out of the grasp of understanding. You did not know where it was going, where it had gone so far, where to push it, what was the next step. With Dick the next step would somehow come out of - divine revelation". Feynman has shown some unique iconoclastic behavior - he refused to continue as a member of the prestigious National Academy of Sciences of which had been elected a fellow. Despite protracted correspondence between the President of the Academy and Feynman, he managed to step out of the membership. This is really unusual since most scientists clamor to become fellows of prestigious academies, and his reason for dropping off from the academy was simply that he did not believe in judging the merit of people (whether such an attitude is indeed appropriate is another matter).

In a series of three lectures at the University of Washington (Seattle), he expounded the relationship of science to a wide ranging set of questions of society - largely, what cannot be or can be settled by science and if and when it could be settled by science, how the methods of science can be used to help make judgments. In his student career, he became a subject of hypnotism in

one of the lectures on hypnotism and concluded that hypnotism has validity even though at start he had great suspicion. He went through experiencing sense deprivation hyper-baric tanks in an attempt to examining altered states of consciousness.

Finally, he faced his death remarkably. Diagnosed as cancer in the abdominal region, he suffered for some period and finally recognized that his death was near and spoke during the last few moments thus - "You see, one thing is, I can live with doubt and uncertainty and not knowing. I think it's much more interesting to live not knowing than to have answers which may be wrong. I have approximate answers and possible beliefs and different degrees of certainty about different things, but I am not absolutely sure of anything and there may be things that I do not know anything about, such as whether it means anything to ask: why we are here..."

I do not have to know the answer. I do not feel frightened by not knowing things, by being lost in a mysterious universe without any purpose, which in a way it is as far as I can tell. It does not frighten me..."

He lived with a consistent intellectual position about many aspects of life till the end and did not attempt to rationalize weaknesses and lived most of his life for uncovering the secrets of nature as best as he could.

Roger Penrose

Rouse Ball Professor of Mathematics at the University of Oxford, noted for his outstanding contributions to mathematics, cosmology and a mathematical problem related to the way of filling space with geometric shapes that have been known as Penrose tiles. He has also been very brave to think through the important question called "mind-body" problem and defend his "anti-strong AI" position through a number of arguments drawn from quantum physics, cosmology and mathematics. He worked with Stephen Hawking on a theory that showed that if the theory of relativity holds, the presence of black holes implies a singularity. All these contributions have made him a truly outstanding mathematical physicist. Many aspects discussed in this article draw heavily from his exposition of the thesis related to mind-body problem. After he wrote his celebrated work, "The emperor's new mind", he wrote "The shadows of the mind" and "The large, the small and the human mind", the last work having written comments by Abner Shimony, Nancy Cartwright and Stephen Hawking and responses by Penrose to their comments. There is a large overlap of ideas between the three books and the central ideas have not varied in these books. The discussions are very clear and understandable in most places. Some of his ideas have been strongly criticized by a number of scientists especially in the area of artificial intelligence and equally strongly defended. It is a treat to read the criticisms and the defense of these criticisms. What I have observed in his books is that in some portions that are understandably speculative, the

presentation could perhaps have been briefer rather than being obsessively detailed.

Structure of Matter

That matter was composed of atoms was known from the early part of the nineteenth century, and yet, it was only in the last hundred years that the structure of matter has been firmly traced to atoms. Till the early 1930s, only three particles were established - protons, neutrons and electrons. Photon, though known already, was not respected as a fundamental particle. Neutrino was still gaining credibility. By 2000, atom was smashed with higher and higher energy particles using accelerators and other particles or effects of unobserved particles found. The structure of matter has been now established to be composed of 24 fundamental particles, classified into leptons, quarks and force carriers. Electron is contained in the Lepton family. Proton and neutron are composite particles made up of quarks. Force carriers are particles whose creation, destruction and exchange lead to forces. Photon comes under the class of a force carrier. Each particle is characterized by mass, charge, spin, particles to which it may decay and the mean life.

It appears that more of the fundamental particles are those whose effects are observed rather than particles themselves. The question of position and velocity of these particles is controlled by Heisenberg's uncertainty principle to a degree that the smallest observational influence to determine one of these accurately can affect the other strongly.

It is useful to recognize that all matter - inorganic, organic or biological - is composed of electrons, neutrons and protons (and therefore fundamental particles). Some biological matter expresses itself with consciousness to varying degrees. In case of some species like human beings, chimpanzees, monkeys, dogs, some birds, fish like dolphins, it is clear consciousness can be assigned, but with several other species, like "cockroaches", it is not clear whether one can assign consciousness at all.

The Upanishadic saying "sarvam brahma mayam jagat" is indeed clearly brought out by the fundamental nature of the structure of matter. One might also say "sarvam fundamental particle mayam jagat". The energy mass equivalence is so vital in the exchanges that occur at the sub-atomic level that it is entirely correct to say "sarvam shakti mayam jagat".

Science and Vedānta

In discussing the connection between science and Vedānta, there are several possible ways of expressing the issues and analyzing them. Many of these approaches are important to get a better appreciation of the issues. However, it is useful to begin with an approach that arises from what appears as ground

state. This is - to begin the discussion from a simple understanding of our experiences and probe inwards.

As the developments in science and technology have progressed over the last five decades, particularly in the areas of miniature electronics, computing and biology, there has been a feeling amongst many scientists that brain is essentially a biological computer and a robot can be designed to simulate all externally observed processes in a human being. The initial similarity begins thus: the biological system converts food into energy and this sustains the living process and allows other functions to take place; in a computer, one needs to power the system with a battery, for instance and then only it will begin functioning. Then onwards, other interactions of the human mind with the world can be simulated by robot. This position is termed as Strong Artificial Intelligence (SAI) by RP (Roger Penrose). A large number of current day scientists and some leading biologists (like Crick, the Nobel prize winner for the discovery of DNA) support this position. Much before the discussion on whether this position is correct has begun vigorously, many scientists of earlier years like Schrödinger, Arthur Eddington, George Wald (Nobel laureate in Physiology and medicine) have expressed a view that life processes involve more than expressed by the SAI position. Since the extra component of life normally called “consciousness” by some and “soul” by others, is outside of perceivable elements, the question is whether this stuff called consciousness is outside of computer based processes. The position held by RP based on a large number of observations interpreted by him and detailed arguments using mathematics is that consciousness is beyond algorithmic framework. Approach to it can only by non-computable means. This implies that AI cannot simulate consciousness.

The position held by Indian seers over the last three thousand years is similar. Soul or consciousness is beyond the world of duality. It is the fourth state, “Turiya” apart from wakeful, dream and deep sleep states. It is the one where the observed, observer and the experience of the observation are absent. Even so, one should not hurry and repeat the oft-heard statement that all that has been stated was known earlier. The approach taken by RP that, one can appreciate, is in the realm of science could have a different and profound significance in its relevance.

The argument made in the book is simply stated below. Suppose the mechanics of functioning of the brain is like a computer. All computer functioning is by algorithms. A sequence of “Yes” and “No” statements lead to 1 and 0 that would be finally interpreted in terms of a text or numbers. The question posed is whether the world of mathematics that uses an axiomatic system in its development is complete so that all processes of brain captured? This is answered by the famous theorem due to Gödel (in 1931) that states that “any precise formal mathematical system of axioms and rules of procedure whatever, provided that it is broad enough to encompass simple arithmetical propositions that are free from contradictions, must contain some statements

that can neither be proved nor disproved by the procedures of the system”. Another simple way of expressing it would be that any axiomatic mathematical system is always incomplete. The implications of this statement shook the world of mathematics as it upset the most conventional thinking held for a long time. This theorem would lead to a consideration that the brain functioning cannot be simplified to algorithmic functioning **since if it were so, the description of the functioning of the brain would be incomplete** (in this argument, one would expect that the functioning of the brain cannot be incomplete; hence this argument is incomplete).

A series of experiences of several scientists on the solution to scientific problems being contemplated by them in which the solution to problems appears to have occurred spontaneously at random moments when there was no “conscious” effort on their part to resolve the problem is used to draw **the conclusion that the process of creativity is non-algorithmic** - there was no sequence of arguments or logical statements in their mind before the solution, some times the entire sequence of issues to be resolved for the appropriate solution has occurred spontaneously.

The third part of the discussion is related to explaining the origin of the non-algorithmic nature of the mind through the “mysterious” character of quantum mechanics that is the foundation of the world of the “small”, and the details of the signal transmission between the sensory organs and the brain to construct a structured hypothesis on non-algorithmic nature of consciousness.

It is necessary to understand and appreciate quantum mechanics and the role it plays in understanding the world. Quantum mechanics is the basis of the stability of the atomic structure, the forces that hold the molecules together, lasers, superconductors and super-fluids and a number of scientific aspects as well as technological features. The puzzling behavior of quantum mechanics has been discussed at several levels - popular to deep rigorous level in a number of books over the last fifty years. More popular accounts have appeared in recent times. The key complexities are summarized in several experiments - (1) double slit experiment, (2) Wheeler’s delayed choice (3) EPR paradox resolution through Aspect experiment, (4) Schrödinger’s cat, and (5) Terry Clark’s large quantum particle.

Double Slit Experiment

The key experiment that can be shown to bring out the key features of Quantum mechanics is the double slit experiment that is taught to students of physics regularly and explained clearly with all the variants in Volume III of Feynman’s lectures on Physics. As such, it is not presented here. The essence of the experiment is to seek the results of the passage of large size objects (say, bullets), photons (light) or electrons when they are fired from a source and they pass through one of the two or both the slits in a wall to reach

another wall at a distance containing suitable detectors to determine the arrival of the material shot out from the source. The conclusion is that electrons or photons behave in a way very different from bullets or large size objects - large objects move like particles through the slits and arrive at the detectors and the results of the arrival of the material with both slits open can be obtained by a superposition of the results for individual slits. This behavior is like a particle. In the case of electrons or photons, the result that one obtains for both slits open **needs** a superposition of the **wave behavior** through individual slits - not only that the superposition should have associated coefficients **that are complex numbers** [$w_1 | (1) + w_2 | (2)$] where w_1 and w_2 are the coefficients. Because of the wave character, there are locations where the waves cancel and others where they reinforce leading to a result that has peaks and valleys in the final result. Further, if attempt is made experimentally to determine which slot is being used by the electron or the photon at any instant, this process itself fixes the hole - either one and the result will appear like in the case of a bullet - the act of observation that fixes the route makes it behave like a particle. If the observation is made subtler and subtler, say by using low intensity photonic source, till the threshold of intensity is reached below which the route cannot be observed, the wave behavior is expressed. Other experiments have been conducted with single photons being shot out of the source periodically. Even these show up a wave like behavior when one puts together the results from a large number of photons received at the detector. From this experiment, it appears as though the individual photon splits into two waves and on passage through the slit, interference is caused leading to the observed behavior.

The explanation for the wave like behavior is that the electrons or the photons use both the paths (and all the paths if there were other slits) individually and create the interference pattern. However, when the system is observed, the multiple paths collapse into a single one leading to the particle character. This is expressed in a rigorous manner as follows: on the standard account of quantum measurement, originally due to John von Neumann, the act of observation discontinuously projects a quantum system into one of the basis states--represented as a set of eigenvectors spanning Hilbert space--for the observable operator in question. This is called state vector reduction in classical quantum mechanics.

Delayed Choice Experiment and Others

Proceeding further, Wheeler suggested a delayed choice experiment. In this experiment, the photons are split into two parts by using a half-silvered mirror, one part going through one mirror and another part through another mirror. These are directed and combined in a fourth mirror and taken to two detectors - each directed to receive the photons from the two different paths after they are combined in the fourth mirror. Again, the experiments could be performed by shooting photon by photon and receiving the output sequentially. The first

half silvered mirror splits the beam into two and half of it is reflected and the other half passes through the mirror. At the fourth location where the two beams arrive, it is possible to let the beams pass as they are or combine them such using a half silvered mirror that could cause interference between the two and ensure that one side detector receives no output and the other side detector receives all the output. In case there is no half silvered mirror in the fourth location, both the detectors will receive half the output (half the number of signals). When half-silvered mirror is in place, one can expect that one mirror will not receive any and the other will receive all the output. If we now ask what will happen to a single photon in this case, the startling result is that it will appear only in the second detector and nothing will be obtained in the first detector. This means that the photon must have broken up into two paths and reached the fourth mirror, interfered with itself and produced the result that was obtained. Next is the case of delayed choice. If, after the photon has been emitted and a suitable time delay (in terms of nanoseconds), one of the paths is disabled by blocking it, the classical result will follow - with no half-silvered mirror in the fourth location, the photon will appear in the detector facing the path that is left open and with half-silvered mirror, it will appear on both of them, roughly half on each side (see p. 328 - 331 of RP's "The emperor's new mind" as also p. 235 - 238 of Ford's "The quantum world"). These experiments indicate that the photons that came via two directions were still connected to each other all through - called entanglement feature. This feature is not limited to the distances considered in the experiment, of the order of a few meters - it could be kilometers or billions of kilometers - light from stars from distant galaxies could behave similarly. The fact that the photon splits into two waves traveling out in separate directions has a restriction that they belong to a single photon and so one can interpret this that the photon is in two places at once - a **double of each other** flying away till they are brought together to merge or cancel suitably. The presence of a double reminds the don Genaro's demonstration of his "double" feature in Carlos Castaneda's book "tales of Power".

While the features noted above have been tested out in other experiments, one experiment where the solution has been still found unsatisfactory is the Schrödinger's cat. The reason for the dissatisfaction arises from the fact that the deciding event has in it "consciousness" for the difference between a live and dead cat lies only in consciousness.

The EPR (Einstein-Podolsky-Rosen) paradox has also been resolved experimentally after the death of Einstein against their proposition. If we expand the understanding of these experiments, it appears that nature as it exists is not "something" that is limited to what we observe. Because we observe, we see what we see. These words could as well have been taken from a text of Vedanta - Ādi Shankara has set it out in his commentary on Brahma Sutra Bhāshya. The classical view of Māya attributed to him can be interpreted in terms of these words.

The entanglement of photons seen in the above experiments (as also true of electrons and other fundamental particles that can be subject to experiments) raises questions as to why they are not seen in objects of larger sizes. Is it a matter of rationalizing the observations or it is our limited vision of the universe that creates what we experience?

Hamiltonian Approach and Least Action Principle

A parallel subject that has bearing on the theme discussed above is the approach to solution of problems in mechanics (including quantum mechanics). While the equations of motion due to Newton constitute one approach to solution to problems in mechanics, an equivalent formulation due to Hamilton and the variation principle associated with it constitute the alternative. The principle of least action is another associated solution technique. These are again text book material that have been taught and used over several centuries. The essential point is that minimization of a certain integral (of Lagrangian = Kinetic energy - Potential energy) between the end points in space or two time moments becomes the equivalent of the solution of the equations of motion. It can be shown that these approaches are mathematically equivalent. Yet there are philosophical differences. While the solution of equations of motion are essentially point-to-point or moment-to-moment progress of alternate paths and a process to obtain the minimum, the minimization principle constitutes a global approach to get to the minimum. As Gleick describes it “Feynman’s path integral view of nature... the principle of least action, the principle of least time” all come from the same thinking strategy. A related question is: in obtaining a least time path, does light or photon try out all possible paths? It appears as though the answer is “Yes”. This position is similar to the photon breaking into wave packets and trying to pass through both the slits and interfering with each other. It would also try other paths, but those are blocked by the wall. An enticing conclusion is that photons (as well as fundamental particles) are **aware** of the entire environment and act as such.

Tiling and Crystal Growth

An associated phenomenology in mathematical physics is concerned with space filling - tiling of planar region as well as crystal growth in three dimensional space. In the first case, the question is posed thus. Given a tile geometry or a few sets, can the plane be completely filled without gaps? This problem has been explored by several mathematicians and one problem is famous as Penrose tile problem. Firstly, it has been mathematically shown that there is no algorithmic procedure for tiling a plane with a-periodic tiles. This does not mean the plane cannot be tiled - but there is no decision making procedure to do that. In fact Penrose tiles do fill the space. But they are a-periodic. They have a **near**-translational symmetry, and a **near**-five-fold symmetry. The five

fold symmetry is forbidden in normal crystal growth behavior. It is possible that crystals of such near-symmetry are grown in three-dimensions with the atoms located at the corners - such crystals are called quasi-crystals. The key point about the growing of these crystals is that their formation has got to be **non-local**. If human intelligence is to be used, there needs a periodic check on the error-free assembly and redoing if there is an error. But then, if nature does it, how does it happen? A large scale optimization procedure that minimizes the energy for the specific configuration of the atoms is required. This is in fact what nature accomplishes when crystal growth of this kind occurs. It is thought that a simultaneous quantum superposition of several arrangements must occur and out of this one gets realized like what happens in the two-slit photon experiment with both slits open.

Freewill and Fate

The subject of freewill and fate are common subjects of discussion in religious writings and discourses. This subject can be a matter for scientific discussion as well and has in fact, been discussed by RP and others. Since the equations that govern the motion of objects, waves and electric charges - Newton's equations of motion, Maxwell's equations of electromagnetism and Schrödinger's equations of quantum mechanics are all deterministic (in the case of quantum mechanics, probability enters when observer participation occurs), evolution in time is fixed once the initial conditions are stated. The question of providing accurate initial conditions is limited by Heisenberg's uncertainty principle. The evolution of large scale systems which is what is of interest generally could be affected by the sensitivity to initial conditions, a phenomenon known as deterministic chaos, explored extensively in the last five decades. The argument therefore, is that evolution into future even though computable is noisy. A simpler corollary is that if we can define the system at the present moment, we can use the equations to trace back the path into the past. This is in no conflict with any aspects of science and experience.

A rather peculiar finding that I have seen in the evolution of chemical systems in combusting flows (with flames) is that even though a simple model chemical system shows up aspects of deterministic chaos, complex chemical systems with chemical, thermodynamic and transport properties fixed by their native chemical structure **shows up hardly any chaos**. This allows for a speculation that uncertainty in the initial conditions may not always be amplified through the equations of motion in complex systems since several complex interactions may dampen them.

A deeper argument proposed by RP seems even more plausible. The evolution of the universe from the time of big bang is entirely fixed. This implies that there is no free will. This may sound harsh and difficult to accept. Only careful observers of life in a large number of situations can notice the elements and the limitations of free will and can see the role of fate. However, it is also

appropriate to know that we are not aware what awaits us or the universe in times to come as it is non-computable, since it is non-algorithmic. The role of consciousness in being able to capture the future is not excluded. Observation by people who have spent long times in meditation is that the noise in the mind precludes signals of future being captured. If the noise is brought down, and it is willed that some aspects of future be known, there is increasing capacity to see into the future. And willing that some thing happen different from what one becomes aware (of things to come) to show how free will operates rarely arises as there is equilibration in the mind of why and how certain things evolve as they should. This is some what reminiscent of the experience of Feynman when he went through a demonstration of hypnosis as a subject. After he was hypnotized, he wanted to disobey the instructions by the hypnotist. His mind got into state in which he would say, I think I can disobey, but I won't. As Feynman himself describes it "this is just another way of saying, I can't". Perhaps, all of us are hypnotized by nature!

Consciousness and Brain

RP is one of the few mathematical physicists to have given great thought to the relationship between brain and consciousness. In his discussion he is caught up some times in what appears a thin dividing line between the strong AI position and the evidence for consciousness. There are several questions for which brain research has led to clear answers and these should be taken into account in understanding the role of consciousness. One question that has been raised is where does consciousness lie? It is certainly not found in any part of the body other than brain. Investigations have been made to determine the location inside the brain. Cerebellum is more an automaton than the cerebrum. The autonomous functions like of the heart, lungs, and reflex actions for survival all are sub-conscious activities relegated to cerebellum. In fact, most repetitious activities get off-loaded to the autonomous functioning mode. Keeping oneself alert, awake, and aware, (that is the role of cerebrum) is in fact a task on which one can neither put in effort nor withdraw from making some effort since putting in effort leads to resistance and withdrawing the effort leads to random thought process. RP describes several experiments on split brain, blind sight and other aspects and the final position of the seat of consciousness is not clear. It appears many parts of the brain do part-functions and they may all be needed to express consciousness fully.

A discussion he presents on the relative role of conscious and subconscious parts of the mind seems interesting (p. 531+ of The emperor's new mind), but the writing appears more complex than needed. He indicates that most opinion is around the fact that conscious mind is rational and the subconscious mind is mysterious where as he holds the opposite view. His thinking is that while subconscious is possibly algorithmic, but judgment forming that is the hall mark of consciousness is a part of conscious mind.

I will argue for a position closer to “the public opinion” but in reality may be no different from RP’s position. I want to define a part called non-conscious mind, where both algorithmic and non-algorithmic functions take place. The algorithmic part may well be identified by what is classically understood as sub-conscious mind. Whenever complex problems are tackled by the mind seeking routes to penetrate the issues involved, considerable conscious thinking takes place. This might also involve reading, as well as discussions with colleagues, and peers. Quite often, solutions do not emerge in these efforts. One needs to break away and perhaps “submit” the problem to the non-conscious part, by essentially diverting the conscious part to other issues on hand - say, discussing politics, local or global, partying and so on, taking the mind away from its burden. After a nice sleep over a period of time, thoughts suddenly present themselves as alternate routes to the vexed problem. At this stage, the conscious mind reviews the solutions and pursues one or two or may reject all, remitting the problem for further cooking to the non-conscious mind. Even where the suggested alternates are being pursued, a second round of refinement may be needed and this might involve part conscious and part non-conscious activity. In some way, the consciousness of the individual is involved all through, since even during sleep or other altered states of consciousness, a basic substratum of consciousness must prevail. There is also evidence for this viewpoint in RP’s book where he indicates for instance, that patients needing surgery subject to anesthesia recollect later some conversations between the doctors at the time of surgery.

In a subsequent book, “The large, the small and the human mind”, RP sets out ideas on the relationship of quantum mechanics to the mental processes, in particular consciousness. The elaborate structure of the brain responsible for signal processing is traced to microtubules (part of neurons) that are connected to other micro tubules through a dendritic spine and a synaptic cleft. The microtubules that have walls made of columns of tubulins that are only about 4 to 8 nm thick sustain large scale quantum coherent activity inside the tubules. This position has been contested by Stephen Hawking, but defended quite vigorously by RP. Since not much has happened in this area over the last ten years, it may be assumed that these thoughts are still in the stage of hypotheses.

Reincarnation (Rebirth)

This is a subject that is a part of religion as well as pursuits of scientific studies aimed at establishing the empirical features on a solid foundation. The scriptural tradition expressed in Bhagavad Geetha tells of Krishna proclaiming “where as I know all my thousand previous births, you do not know ...” It is also used as a standard explanation for the variety seen in lives of people - “good” people experience an unexplainable sequence tragedies and “bad” seem to go up in a life of comfort and good life. The standard explanation is that in the earlier birth, a currently “bad” person had done lot of “good” in the previous

birth and that is why he is reaping the benefits in this birth and all the “bad” he is doing today will accumulate and he needs to pay for it some time in this birth or the next. The currently “good” man has to pay for what he did in the previous birth. Very clearly and loudly, people proclaim the analogy of a bank account and recommend that we do as much good as we can so that our bank balance of good improves and we can reap benefit either in this life itself or certainly in the next birth. A further fact used in the arguments is the occurrence of child prodigies and geniuses. For instance, how could a child of three or four know all the rāgās in Carnātic music that requires a decade of training?

I wish to argue that the invoking of **reincarnation is an irrelevant interlude** in the conduct of life. Why should I be “good” - not simply to increase my bank balance of “good” deeds to make my life better in a later part of my life or in the next life. I do not worry about the next life, because as a matter of statistics, almost nobody has any idea of the previous birth, if there was any continuity of this nature at all. Next, I intend being “good” in the society as a matter of self-preservation. Do good unto others as you expect good from others. If you feel well for the environment, you can generally expect a similar response (not always so, otherwise, why would you need a regulatory authority like police). Further, if one were to think a little deeply, one could get confused by what is “good”. Would “Robinson Hood” be considered a bad man because he took away the money from the rich and distributed to the poor in society that collected more taxes from the poor and allowed a few rich to enjoy. Such examples are many in life. You donate money for a philanthropic organization helping out the needy and end up discovering after a while that there has been substantial leakage of money with little reaching the needy. Have you done “good” by donating the money or do you feel regretful that you provided more money for an unintended group or person to do something “bad”. You might say, “No, I did a good thing at the time I donated money, my conscience is clear. What the organization did is their problem, not mine”. Alright, I accept. What happens if the same organization came back to you for donations? You will perhaps make enquiries as to whether the intentions at this point are indeed noble and act accordingly. But somewhere in your mind, you begin to think deeply about the process of giving donations and their value in a complex world. The implication of all this is that ideas of “good” and “bad” are not digital and simply evident in life. The only observation that can be made is that when doing something significant, it may be very useful to allow a clean and quiet mind to contemplate and take a decision and act. The final act is neither good nor bad, it is simply an action. Hence connecting “good” to “bank balance” is not needed.

How can we explain the occurrence of child prodigies? The evolutionary feature in nature leads to a variety of species with talent on occasions. The statistical variation in the evolution of species allows very dumb to high talented species in the offspring. If we take this to be a normal distribution over a suitable large

sample size, as it indeed would be, one end of the tail belongs to prodigy and other to dumb and hence there is nothing surprising in these observations. The act of birth carries at the finest DNA level, many characteristics of the parents, grand parents, great-grand parents and even earlier generations and this is responsible for what is observed. What happens is a simple statistical fluctuation. One does not have to invoke continuity of the same life as the explanation.

At this time, we can ask ourselves if it makes a difference to the conduct of life by invoking reincarnation or otherwise. By believing in reincarnation, can we postpone what ought to be done now to the next life? I think not. Hence, the aspect of reincarnation is simply irrelevant to the conduct of life. By being concerned about it, we might make our life more miserable and it is desirable to drop off being concerned about aspects outside our control. We are here today and we examine what can be done with life rather than think differently.

Summary

The universe is composed of fundamental particles. Cosmological evolution led to conditions in certain parts of the universe where “life forms” could exist. At this time, however, it is only on one planet - earth that such conditions have led to what we see. Life forms evolved over millions of years into life forms with consciousness including human beings. The universality of the relationship between “the large” and “the small”, namely, the fundamental particles is central to science and Vedanta.

Considerations of mind being a computer (that is, algorithmically based) are disputed on the basis of the fact algorithmical base is incomplete due essentially to Gödel’s mathematical theorem and to say that mind is incomplete (or limited to algorithmic functioning) is inconsistent with experience.

The range of experiments and theoretical conceptualization about the “small world” shows that the behavior of the constituent elements - photons or electrons is **non-local**. The non-local behavior implies every element is connected to every thing else and the behavior even in an extended “large world” indicates to a certain degree of **awareness**. This provides a hint to the possibility that all inorganic and organic matter may have inbuilt awareness. It is to internalize this understanding and also be conscious of the universality that efforts of mysticism and religion are directed. The aspects of happiness, peace of mind, broad mindedness that one attributes to the result of religious practices are all an outcome of the centrality of these thoughts in the mind.

On the matter of free will and fate, it appears that we are all fated to move in a cosmically directed path. Lack of awareness allows the play of free will and fate in a mind that is usually noisy.

Attempts to determine the location of **consciousness** (consciousness is “active” and awareness is “passive”) shows that this is largely in the cerebrum with the cerebellum, the ancient part of the mind involved in the critical life sustaining routine functions. The elements of brain responsible for signal processing, namely components of neuron - microtubules are argued to function on a quantum mechanical basis, a feature still to be established. It has been suggested this segment that would be responsible for consciousness, a matter still under examination.

Reincarnation as a fact may become a subject of research, but, as an individual there is no need to be concerned with it as this aspect poses an unnecessary burden that has no useful feature in the conduct of life.

Vedānta

The subject has been pursued in India over the last several thousand years and the primary focus of Vedanta - to understand oneself, to achieve nirvana, to internalize “Sarvam Bramhamayam Jagat” - has been dwelt upon and dealt with by mythical and historical personalities. A whole range of Rishis, Vyasa, Vasishtha, Vāmadeva, Vishwamitra, Agastya, Durvāsa, Patanjali and many others belong to what I term as mythical personalities. I use this terminology not to denigrate their greatness, but to say that there is no valid historical evidence of their life before and after they achieved an evolved state ascribed to them. Many important religious, mystical works are associated with them. The famous Yoga Vāsishtha owes to Vasishtha. The principal “Gāyathri” mantra is due to “Vishwamitra”. The Yoga sutras are ascribed to Patanjali. I do not wish to dwell on these personalities for a good reason. One of the fundamental tenets in Vedanta is that talking or writing is less important than living and acting consistent with the Vedāntic ideals. The recorded life of these personalities is virtually unavailable and hence the possible role model (even in parts) that they may have for a true seeker of truth appears to me to be very limited. On the other hand, historical personalities present a much better opportunity to create the role model even if they did not intend. There are several historical personalities who have influenced the thinking world; I am less keen on examining theoretical prescriptions and discussions. I would like to consider those who have been credited as having climbed the ladder of experience to a level not easy to judge precisely, but yet it is clear that the level of distinction achieved is far above a level that I think (which is not vastly different from what several of my colleagues think) as a mean level of distinction achieved in the conduct of life. I will consider a limited set - Buddha, Âdi Shankara, Ramakrishna Paramahansa, Ramana Maharshi and Chandrasekhara Bhārati of Sringeri mutt simply because of (a) detailed writings on their life or (b) familiarity of these personalities through their critical writings or those by other distinguished people.

Sanyāsa and Avadhûta State

Sanyāsa is one of the four states of functioning in the society. A sanyāsin relinquishes all possessions of life at whichever stage he (could be “she” as well) is in and functions on a day-to-day basis without the thought of acquiring possessions and planning for a life. His relationships with others in the society are uniform as though he sees “self” in every other person or even an animal. He functions with simplicity in life with minimal most of the needs - food, clothing and shelter, does not demand anything and survives by what is offered at the minimal mode. He conducts himself as a person involved in contemplation seeking his “self”. He is expected to wear ochre robes (kāshāya vastra) for him to be reminded on the serious role in the society and the society to respond to it. Sanyāsa is generally held in high esteem by the society. Traditionally, responsibilities like the heads of a religious organization are held by Sanyāsins, as they function by holding the position as a trustee-manager in one role that they need to discharge. That serious distortions in the functioning of sanyāsin-led institutions have occurred at various times indicates the lack of demand of highest integrity from such offices by the interacting society. Also, it is not easy to maintain the path of contemplation and meditation until one has truly enjoyed the highest state since most people get swayed by the attractions of life. If in addition, when one is positioned to receive the highest respect of a large number of distinguished people in the society, and these constitute a large amplification to even a subtle ego, it is even more difficult to withdraw oneself into solitude. There are however, select individuals who have discharged such responsibilities in a befitting and remarkable manner, like Chandrasekhara Bhārathi amongst the individuals identified earlier.

Avadhûta state, in a way, is one that is even more evolved compared to sanyāsa. In this state, the person concerned has evolved so much that even the rules of sanyāsa do not apply. It is a state of bliss or post - nirvana in which the person conducts his life in a manner that he demands nothing from the environment - food, shelter or clothing. He might move around aimlessly and irrelevantly; but when he chooses to interact, it would be blissful to those who come into contact with such people. A sanyāsin could evolve into an Avadhûta. Even a non-sanyāsin could get to the stage of an Avadhûta. Sadāshiva Bramhendra is a well known Avadhûta having attained this state bypassing the formal sanyāsin’s state.

Bhagavān Buddha

The way Siddhartha evolved into Buddha is very relevant to many (like me) because he went through the early part of the life as a very ordinary person with a family, however keen an observer or thinker he may have been. If his life had ended along a course similar to what it was till the time he made a radical departure in his youth, history would have forgotten him. The fact that

he spent the next seven years in a single minded way to the complete exclusion of any thing else to seek answers to fundamental questions of life distinguishes him from most seekers. I suspect he was also basically very intelligent (the word used in the traditional sense), something that is not described in any detail in any well researched history on him. I infer this because, even though there were several practitioners of Vedanta in his period, there must have been too many involved in the practice of “isms” rather than the core of Vedanta and there was not any “core” stuff that he could be deeply respectful of. For him to pursue, ability was needed to turn away from the unsatisfactory, when really, the pathway to the satisfactory was not clear; this needed intelligence apart from strong instinctive feeling. I am emphasizing the aspect of intelligence since the discriminative ability is not always instinctive unless a person has already grown internally and the noise in the mind is very small. Hence for the uninitiated, intelligence has a strong role.

The principles of Buddhism evolved even in his life time quite substantially. Even later, there were several schools of Buddhism that evolved in India, Tibet and other parts of the World. Buddha had a large number of disciples, some of whom had evolved nearly as deeply as he had. His disciples went about preaching the Buddhist principles in India and various parts of the Eastern World - Tibet, Srilanka, China, Myanmar, Cambodia, Vietnam, Thailand, Japan, and other countries. In most of the east Asian countries, it has a strong foothold even today. It has also spread to the West and most large cities in Europe and America have Buddhist centers. Many people are moved when they read the Buddhist teachings.

The principal teaching is to conduct a life in a manner that one is at equilibrium with oneself all through the life. There are several working rules and guidelines that provide input to day-today life.

Âdi Shankara

The early life of Âdi shankara is not known accurately. Ramachandra Rao has researched into his life and writings in a not-too-well publicized but an outstanding book “Shankara and Adhyāsa Bhaāshya” in which he has examined various aspects of the historicity of life and works of Adi Shankara. His period has been assessed as between 650 to 800 A. D. His life span was brief - 32 years. It is however, clear that he must have been a very deep personality with intelligence, wisdom and experience of the highest order to have (a) written commentaries on the Upanishads, Bhagavatgeeta, and Brahma Sutra Bhāsyā and produced scores of other Vedāntic writings and (b) traveled a distance of about 6000 kilometers twice in his short life span from deep south to Himalayas and Kashmir in a period of time when traveling was perhaps extraordinarily difficult. In this journey, he was challenged by other traditions that had developed over a period of time and he overcame all the challenges including the Buddhist monks at that time and left behind a strong religious and Vedāntic

influence over the entire country. He left behind a structure of religious institutions in the four corners of the country that has stood the test of time for the last 1200 years, some thing about which one should be deeply satisfied.

A book entitled “Shankara Vijaya” describes his life history in a manner that ardent devotees would do making it difficult to extract historical truth the way we perceive it today.

Sri. Chandrasekhara Bhārati

Chandrasekhara Bhārathi grew up as a child (named Narasimha Sāstry) in a family that had lost thirteen children born earlier to him either at birth or at a very young age. The family depended much on him as the lone surviving child in their family and also an improved living standard that could be obtained by modern education and the concomitant benefit of a secure job. He was into traditional modern education in the early stages and was into Sanskrit education later. At a young age of 20, he was drawn into the Sringeri mutt as its head with somewhat-reluctant parents accepting this situation. Coming from poverty, being shy in temperament and with demands of being beholden to others who took care of the daily needs of him and his family, it was difficult to for him and the distinguished people around in the Mutt to reconcile to his elevation as the head of the Mutt. Surely, the wisdom and foresight that the earlier head of the Mutt, Ugranarasimha Bhārati is to be recognized because this choice of his was not the one anybody else had even dreamt of.

Even as the Sanyāsin-head of the prestigious mutt, he continued the learning of traditional Shāstrās under the tutelage of several scholars. Soon enough, he determined that his role would be more appropriately dealt with if chose the path of contemplation and meditation, even though as the head of the mutt, he had to reluctantly discharge the religious role to secure greater strength of devotees and so, prosperity to the mutt. His life towards self-realization was tumultuous and he was suspected to have gone “mad” and efforts were made to send doctors from NIMHANS, Bangalore to have him treated. Such acts resulted in strange experiences to the doctors concerned who had to return without even examining the patient. During this period of tumultuous behavior he was involved with himself and had no concern for the surroundings. Subsequent to this period, he is supposed to have achieved a state of inner poise experienced by most around him or those who visited him. Conversations during this period were brief, instructive and effective. There were many who benefited from his advice and directions in life. Some were blessed as well.

Amongst what appears as puzzling behavior, he seems to have stuck to traditional behavior to a degree not entirely consistent with an exalted understanding that self-realization is expected to bestow. In an era when science had advanced significantly - not simply in terms of technology, but basic revelations in terms of structure of the universe, the insistence on

traditional behavior for nearly all the visitors, for each along a religious path arising out of birth appears incredible. When a person from Christian faith wanted to be converted into Hinduism as he felt attracted towards it deeply, he argued and advised him to pursue the faith into which he was born and become a better human being and grow further in it itself.

A critical and deep appreciation of the character and the personality of Chandrasekhara Bharāthi has been provided by Sri. S. K. Ramachandra Rao (see his book in Kannada language - Sri. Shāradā Peethada Manikya). It appears that the overall conduct of his life can be better described in terms of an Avadhuta. Clearly, intensity of pursuit has been the strongest visible feature of his personality.

Ramana Maharshi

Ramana maharshi was an ordinary student called Venkataramana until a strange experience overtook him at the age of 16. There was no indication whatever of this transformation in him prior to the event. The death experience that overtook him caused an immediate transformation. The next several years that he spent at Tiruvannamalai in various places - a cave in the Arunachala hills, a cave like temple in the main temple at the town seemed to have been aimed at establishing himself in the evolved state. Subsequently when he was established in the Ashram, he could switch himself into that state very quickly. Unless the circumstances around him seemed conducive for him to enter into a state of duality, he would prefer to stay in that state. As to whether it is Savikalpa Samadhi or Nirvikalpa Samadhi, as appears to be a subject of discussion, seems not as relevant as the state though very near, is very far for most. Hundreds of people met him, substantial number stayed at the Ashram and a large number has been influenced by him. He never moved out of the Ashram during his life despite entreaties by several devotees inviting him to come to their town, or their home. He seems to have communicated to many a devotee more in silence than in words. His single consistent answer for any question on the way world is, whether something should be done to improve it and any such related matter was that one should understand oneself first before embarking on doing such things in the world. His simple direction was to enquire “who am I” and delve deep in contemplation. Rest would follow. He did not emphasize yoga or other methods as necessary routes (he did not decry any either). There have been indirect criticisms of these by other modern day messiahs indicating that the simple approach of asking oneself “who am I” is inadequate, and conscious efforts are to be made to overcome the “Vāsanās” - the past attachments. In such matters, there is no reason to expect that the prescription of the kind provided by Ramana maharshi is incorrect, since the intensity of the application to the suggested approach itself could cause changes in personality over a period of time and the actions to relinquish the past attachments could happen in an organic manner.

Siddhis, Mysticism and Science

Siddhis (accomplishments, but loosely understood as miracles), are very strongly associated with mysticism. The oriental text that discusses Siddhis is Patanjali's yoga sutras. This text is a collection of short sentences, called aphorisms that describe various physical and mental attainments possible with the practice of yoga. The well known of these is called "Ashta Siddhis" - eight powers - read other's thoughts, become small, large, heavy, light, or fly, invisibility of the body, levitate. There are prescriptions as to how to attain them. In the text leading to these aphorisms, there is a statement that these are distracting and can act as impediments to the progress in the path of self-realization. As a person progresses in the path of realization, these may occur naturally; they should be set aside and one must proceed onwards, lest one becomes enamored by them; their attainment will be an enormous ego-booster and hence will prevent further progress with greater certainty, may also lead to downfall in stature. A second argument given is that these Siddhis will be subject to bad use and hence discouraged. Many saints and scholars agree with this view and preserve this position as a valuable ancient tradition.

I wish to take a clear position opposed to this. I believe every talented human being has Siddhis. Why so far, even dogs have Siddhis. It is well known that their sense of smell is very acute and is used extensively in crime detection. Every distinguished scientist who has made inroads into secrets of nature is a Siddha. When ever questions that bother many people remain unanswered, they are brought to the attention of an expert, a scientist, or a technologist. It is expected that such a person will devise an answer or provide approaches to find an answer. There are several levels in the capabilities - competent, outstanding, unique may be the words used to characterize them at different levels. We accept these as a natural feature in human qualities, understood to be derived partly out of inheritance and partly by training. When these unique qualities get crystallized, it is possible that a large society will benefit from it and something that was unthinkable becomes a commonplace feature. For instance, more than a hundred years ago, people could travel by land and water. After the possibility of flight was uncovered by some Siddhas - Orville and Wilber Wright - things have developed in a short span of 70 to 80 years to such an extent that nearly everybody can fly all over the planet. Take telecommunication - just about hundred years ago, talking to somebody at a large distance without actually traveling and physically meeting him was virtually impossible. Today, making use of a small toy - cell phone, it is extremely simple to talk to somebody as far as away as ten thousand kilometers in a second or two after deciding to do that. I consider this as a great Siddhi. The beauty of this Siddhi is that it does not need any Siddha to arrange the "connectivity" when needed. One can do on once own. All this has been possible because of breakthroughs in science.

Also, even traditionally, whenever a group of people of diverse professions get together and discover that they are together there to receive some professional service that is extraordinary and is not found in most people, they will discuss amongst themselves that the person from whom they are receiving the service is a Siddha. Hence, the idea of a Siddhi and a Siddha are a part of common understanding in Indian psyche. Yet, the man who aspires for it is branded till he actually becomes accomplished and at that time, he is appreciated as a Siddha and benefits obtained. The state entitled “Siddha” is not a single one. There are so many varieties and more importantly, *levels* of Siddhis. The highest levels of accomplishments are the ones that attract the title of a Siddha judged by a much larger discerning community than otherwise.

In this backdrop, my thesis is that it is inborn aspiration of every human being to achieve as high an accomplishment as possible. This means that every body wishes to become a Siddha. A few may get to that state through a combination of genetic and environmental factors and I guess it is always a few, by the law of averages, since higher levels of accomplishments demand deeper perception, greater commitment, discipline and work. Those accomplishments that are obtained in the range of duality using the mental faculties form the part of Science as we know. They may be termed **external science** for convenience here. As these accomplishments become finer and demand greater and greater subtlety, one naturally ends up with questions that demand finer state of the mind. When it is the internal states of mind that need to be cultured, one naturally turns towards mystical practices. These demand even greater perception and discipline as the “stuff” that needs to be dealt with has to be dealt with by the “stuff” only - a self referential and self corrective action. This may be called **internal science**. One might argue that this division that is suggested is precisely why internal science is more difficult compared to external science and hence the natural conclusion that all “science” is pursued in duality and hence is lower than internal science. I will argue that **this division is more cosmetic than actual**. Understanding finer parts of duality and resolving issues, a part of external science needs activities normally under the subject of internal science - I brought up the subject in the section **“consciousness and the brain”** where I have indicated that solutions to difficult problems are obtained by reference to the “non-conscious mind”. Hence, I wish to assert that “mind” is only one and so is science. The relative fraction of the use of the conscious and the non-conscious parts depends on the nature of the problem. If certain issues of one’s mind itself are the ones to be resolved, the non-conscious mind is to be addressed more than the conscious part. To achieve this, one uses meditative practices, a part dealt with in mysticism or religion. And just as the use of conscious part in science can lead to Siddhis, the pursuit of “non-conscious” mind can also lead to “Siddhis”. Further, just as we not only do not frown, but appreciate the accomplishments or Siddhis in Science, we should not frown on accomplishments in Siddhis arising out of “non-conscious” part of the mind.

I do not know if the cynical attitude towards Siddhis by the distinguished people in religion who hold a sway over the community is borne more out of incapability rather than otherwise. They themselves are indeed happy to utilize the benefits of science - both in travel and communication being the most straight forward examples, while they are unhesitant to frown on Siddhis.

I wish to discuss the second point, namely, that attainment of Siddhis by anybody less than a person who has attained Nirvāna (self-realization) can lead to misuse and cause problems to the society and hence attainment of Siddhis should be discouraged. This problem arises even in Science. Feynman has addressed in some detail in his lectures condensed into a book "The meaning of it all". Unraveling secrets of nature is a true pursuit of science. The way it is adopted or used depends on the society itself. Every new development or activity has benign and malignant uses. Take, for instance, the discovery of electricity. Use of electricity gives illumination, motive power, electronic devices (like the cell phone) and so on and is perhaps the greatest contributor to enhanced quality of life in cultured societies in the last several hundred years. In fact, the development index of societies is measured on the basis of the extent of use of per capita electrical energy. However, it can also be used to create electric shocks and bring about death and destruction. Which part to use and how depends on the society (and its ethical structure) and not on electricity itself. It is perhaps true to say that subtler the developments, greater will be the issues of wrong use. One needs to create frame work in the society on the use and misuse of such developments. For instance, the discussions that have gone around in nuclear energy are a case in point. Communities all across the globe did put in effort to discuss and deal with such matters with care. The planet has survived the presence of nuclear weapons for fifty years and perhaps will survive even more.

Hence, it is valuable to recognize positively the motivation to obtain "Siddhis" and construct appropriate regimes for its use rather than frown and prevent its growth. Attempts to prevent its attainment can at best delay but not prevent it. Why do I say this? It is impossible to suppress the innovativeness or explorative tendency of the human mind. All along in the history of mankind, it has been the role of some odd individual or perhaps a small group who intended to do something different from what was around and one small development led to the other and at certain times, "catastrophes" occurred in which people began to benefit substantially from the new advances. Hence, blocking advances by statements of a rhetorical nature will only bring down the influence the group may have on a community or the society.

At this stage, it is important to see what is happening to the subject of the science of the mind, the difficult examination of self-referential nature. The modern tools of measurement have become continuously ever sensitive and minimally invasive using the new tools arising from quantum mechanics and miniature electronics. Brain has become a central object of examination by traditional sciences aided by the sensitive non-invasive class of

instrumentation. For instance, recently, it has been determined how a single neuron can store more than one full image of an individual (note that there are around 100 billions of neurons in the brain). Biofeedback studies on the parts of the brain that become activated by a sensation - extreme heat to a part of the hand - can be used to reduce the pain sensation, thus indicating the possibility of raising the tolerance level of a human being to extreme conditions of heat or cold. It is not that these have happened only recently. Brain mapping when the mind is shown a series of pleasant, enjoyable situations, gruesome situations, pathetic situations has shown the areas that are most active under these conditions.

As early as in 1969 - 1970, Swami Rāma while staying at the Menninger Foundation in Topeka, Kansas allowed himself to be instrumented in a laboratory with ECG (electrocardiogram), EEG (electro encephalogram) and others and showed that he could control the heart beat rate and the well known brain waves, δ (0 - 4 Hz), θ (4 - 8 Hz), α (8 - 13 Hz), and β (>13 Hz) at will [Note: Beta (β) waves are related to wakeful state of mind. Alpha (α) waves are connected with the feelings of well being. Theta (θ) waves represent a state of consciousness closer to sleep]. He is also credited with the ability of tele-kinesis - the ability to move objects at a distance using needles kept at sufficient distance under laboratory conditions (see Pandit Rajmani Tigunait, "At the Eleventh Hour", Himalayan Institute Press, Honesdale, Pa, 2001).

Very recently (2004), Swami Nityananda was examined at the Rehabilitation Centre Neuropsychology department and PET centre of Oklahoma city in USA. His mental state was examined during various states including meditation by using more modern tools - PET and Quantitative EEG. PET (Positron Emission Tomography) uses a radioactive tracer with an analog of glucose and produces images based on the metabolic activity of the cells. Like in the case of Swami Rāma, he could also shift his mental state between several of the modes. At a very deep meditative state, most of the neural activity was shut down and the lower portion of mesial frontal area (an area between the eyes, the location of the third eye was active. (See for a slightly more detailed report their website at http://www.dhyanapeetam.org/Oklahoma_Research_Report.htm).

In both of the above cases, the matter has remained at the stage at which the experiments were performed. Clearly, the aim of the work seems to have been that a mystic in the east should demonstrate to a scientist in the west what mental control means. While this in itself is commendable, how come Swami Rāma (who was active for 25 more years after his experiments at the Menninger foundation; he passed away in 1996) did not initiate the research in India on a systematic basis, the training of several devotees and students and try to examine the relationship between various elements of the human being responsible for the phenomenon. Swami Nityananda gives discourses in India and uses the words quantum consciousness, but it looks as though they are simply words. There does not seem any depth of appreciation of quantum

mechanics and no integration between this part of science and the rest. Also, it does not seem likely that the experiments related to the state of mind will go any further. If only, the state of mind can be understood in some depth, it would add value to making progress on the subject.

Nirvāna and/or Siddhis

The highest state that the practice of Vedānta leads to is called Nirvāna - a state of total inner poise with little dependence on the surroundings for maintaining the inner poise. Such a person may choose to interact with the surroundings or otherwise. In fact, the description of the Avadhûta state is just this. If we now consider a “dumb” person whose responses to external excitations are much muted and the physiology is such that the person is able to show up as not much dependent on the surroundings, one has an observable state that is not easily differentiated from the state of Niravāna. In fact, many Upanishadic declare that distinction between an Avadhûta and a “Mûdha” (dumb) is marginal for an external observer. If this is indeed so, why should there be such an exalted position awarded to the state of “Nirvāna”? If the state that many scientists experienced when they discovered the subtle laws of nature was “ecstatic” one would imagine that such a state would be close that of deep inner poise indicated for Nirvāna. It is also clear that when the subtle laws of nature are discovered, in many instances, one feels the surge of power within as though a new force of control is available. If all this should make sense, I believe that the state of Nirvāna, some thing that has been reached after relinquishing Siddhis on the way, the Siddhis should in fact a part of the experience of Nirvāna, no matter whether it is exercised. I therefore think, the state of Nirvāna considered the highest is perhaps also the highest because an individual who has passed through that state (and can be in that state by volition) must be endowed with Siddhis. Some times, there is an argument made in which demonstration of Siddhis in a person also implies miracles and miracles as a rule should violate laws of nature. All this need not be. If one were to try to explain the functioning of a cell phone or a laser by classical mechanics and electromagnetism without invoking quantum mechanics, it would look as though there is violation of principles of physics. If quantum mechanics is factored into the process of explanation, there is violation of natural laws. Equally, if and when the Siddhis - of the Ashta Siddhi kind are demonstrated, I believe, there will be explanations that will invoke the laws of nature, but not necessarily that may not be limited to those that are known today. In any case, what are laws of nature any way? - a set of observations condensed into statements that allow the possibility of making predictions in seemingly different situations (that are still within the scope of these statements) that will show up as being correct. If this is so, if and when a “crazy” experimental result - an Ashta Siddhi for instance is observed, a suitable “scientific” explanation will be found.

Buddha, Chandrasekhara Bhārati, Ramana Maharshi and Siddhis

All these three persons attained Nirvana in their life and lived even afterwards. They lived a life-after-Nirvana with minimum of a difference between speech and action. In so far as the dependence on the environment for their living and inner poise, they did not care for them in their evolutionary stages. No one of them showed that they could live just as well without food on a daily basis. I am not expecting that they should do this, but to recognize this feature. Of the three, Buddha and Chandrasekhara Bhārati seem to have optionally decided to minimize the intake of food by tradition. If it sounds silly to the reader as to why I am considering this aspect, I will make an argument. It is to be recognized that as one progresses in the path of self-realization, the most inevitable stuff in the ultimate sense is the food as it affects survival. If the person has a decided liking for food “of a certain quality and quantity” and desires that this be maintained, it is clear that person is far from the state of self-realization. If the person shows such interests in a random manner, perhaps, they become qualities of an Avadhuta.

They exhibited Siddhis variously, but did not care for them, something that is not easy to rationalize. Buddha foresaw his death and acted with poise. The transformation related to Angulimāla is a worthy aspect related to the deep inner poise that he naturally had.

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