

Nature of Human Thought

(From the book [“Nature of Human Thought”](#) Published in 2004 and Second edition in 2010. A nice [YouTube video of a lecture on this subject is here](#))

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Almost all of us, sometime or the other in our life has gone through the experience of feeling that somebody is following or watching us. Whether it is a human being or an animal it makes us turn our neck to see what it is and investigate. Similarly there have been innumerable instances where people and animals have sensed danger much before it strikes them. What is the nature of the signal that tells our mind that somebody is watching us or there is a lurking danger and how is that signal generated and sent from the pursuer's brain? In other words what is thought and how is it generated and transmitted?

Since time immemorial mankind has thought, discussed and written about the origin of human thought. The religious writings are basically a discussion on it. Perhaps the greatest treatise on it has been Patanjali's Yoga Darshan, which to my mind is still one of the most definitive and scientific writings on the control of human thought¹. Patanjali's book is the oldest book on Yoga. It is believed that he wrote his book some time in 300 BC or even earlier though there is still dispute about the date. In it Patanjali defines Yoga as control of thought waves. This is probably the first definition of Yoga. He then describes how through Yoga, one can produce concentration and how this concentrated thought can be used to gain physical and spiritual powers for a person's ultimate enlightenment.

This book consists of 195 sutras (Sutra is a Sanskrit word meaning precise maxim) and is divided into four sections¹. Each section

consists of about 40-45 sutras. The first two sections give precise instructions on how to control thought through yogic practice. The third section tells how one gains mastery over natural forces through thought control. This section therefore deals with how a Yogi (person who practices Yoga) can acquire superhuman powers of omniscience, telepathy, clairvoyance, mind reading, etc. The last section talks about how with yogic practice and superhuman powers a Yogi can remove the memories of past births and make his or her mind powerful enough to clear it of extraneous impressions (memories) so that he/she can be liberated from the cycle of birth and death.

Interestingly enough sage Patanjali does not address the central question of how the thought originates and what is the nature of its generation, but gives details on how to control it for achieving mastery over natural forces. However recent developments in brain research make it possible to understand thought, mind and consciousness.

Generally human thought has been considered by philosophers, religious leaders etc. as non-material in nature. However, a result (thought) produced by a physical brain has to be physical in nature and governed by physical laws. I will attempt to throw light on what these laws could be. Most of the concepts presented here are intuitive in nature with very little mathematical formulation.

Scientists have conducted many studies all over the world to find out how the brain works. Magnetic resonance imaging (MRI) techniques, which are non-invasive in nature, are normally used in mapping the brain. Recently scientists have started using functional MRI (fMRI) for sharper images². Thus fMRI scans are taken of the brain under different stimuli which show up on the computer screen as maps of blood flow in the brain. Scientists then say that the place of maximum blood flow is the area where thought of a particular nature is generated. They also say that memory of that particular stimulus exists in that part of the brain.

However, we are still not sure what the exact location of memory is and there are conflicting theories about whether fMRI really shows all the neuron activities for a particular thought. Besides fMRI may also interfere in the thought process since it produces magnetic field, which is tens of thousands of times stronger than the earth's magnetic field.

Nevertheless there is a consensus that a thought is produced when the brain neurons fire. How many neurons fire for a single thought nobody knows. We can however conceptualize that firing of neurons produces a **structure like a hologram** which can be called a thought. We will try to explain the nature of this structure and its attributes in the following sections and chapters.

There are close to 100 billion neurons in the brain (the exact number is unknown)³. Neurons are special cells found in the nervous system of all animals. Each neuron may have thousands of branches called dendrites and axons which connect it to other neurons and thus there could be a minimum of 10^{14} units (100 billion X 1000) taking part in the neural activity. Recent scientific evidence suggests that besides neurons another type of cells called glial cells also take part in communication. Glial cells outnumber neurons by nine to one and can modify the signals transmitted by each neuron³. Thus the number of different combinations for communication and memory production are mind-boggling.

Most of the time a fraction of these neurons fire for “mundane” or every day thoughts such as; what is the color of a shirt, open the door etc. etc. However, for a very deep thought, in which a person may be concentrating on a single subject for a long time, it is quite possible that the whole brain is active and thus close to 100 billion neurons are firing to produce that single thought. The number of neurons firing may also decide how long the brain focuses on a single thought and on its intensity. A deep thought in which a person contemplates and reflects on

a particular object very intensely and almost goes into a trance-like state is called “*Sanyam*” in [Patanjali Yoga Darshan](#). Practice of *Sanyam* also helps in developing a powerful mind.

According to Patanjali the whole basis of Yoga is to achieve *Sanyam* and its use on any object results in its complete knowledge⁴. Interestingly sage Patanjali devotes one fourth of his book on how the deep thought can interact with matter and produce wonderful physical powers for the Yogi. To my mind he is the final word on the control of deep thought and its use to discover God or Universal Consciousness. I will therefore focus on the structure of deep thought and its production and will point out at appropriate places how this structure and its attributes tally with what Patanjali has written.

In order to explain thought, which is a hologram or a geometric structure, we will take help of the concepts of energy-based dissipative structures, chaos theory and synchronization or emergence of spontaneous order. All these concepts show how order is produced from chaos, especially when a large number of variables interact with each other. This interaction produces a geometric structure from seemingly chaotic behavior of these variables.

Dissipative Structures

The concept of dissipative structures was developed in the early 1970s by Nobel Laureate Ilya Prigogine⁵. These are energy-based structures and their shape and size depends on the quality and quantity of energy supplied to the system. For example, if water is heated in a utensil from below, then according to classical thermodynamics the heat energy will produce random motion of the water molecules and this process will continue till the “heat death” of water (total evaporation of water) takes place. In actuality, at a certain temperature and amount of energy input, convection sets in (Fig. 1c). These convection currents

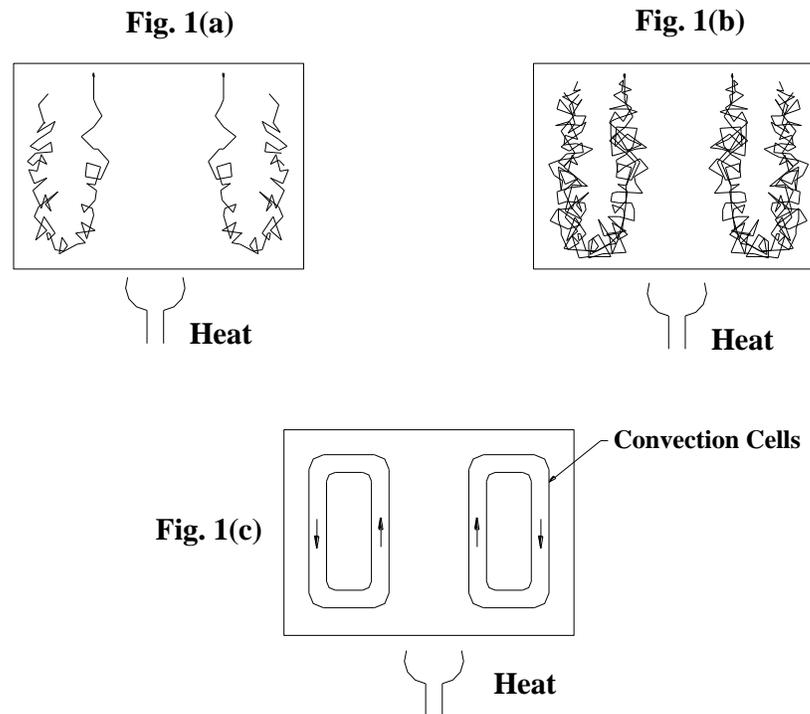
(also called Benard cells⁶) form energy structures which are geometric in nature and take the heat from below and dissipate it above to the surface of water. Hence the name dissipative structures.

These structures are developed in systems which are far from equilibrium and hence are very chaotic, and materialize suddenly when critical conditions are reached. The far from equilibrium condition takes place only when huge amount of information gets embedded in the system⁷. The dissipative structures are therefore like crystallization of information and this concept has been used to explain the evolution of cities, organizations, societies, etc.⁵

One can extend this analogy further and can think of Christ, Buddha, Einstein etc. as such structures, which appear when conditions in the world are favorable (i.e. “chaotic”).

Chaos Theory

Chaos is a characteristic of dynamic systems and was defined by Edward N. Lorenz, the father of modern chaos theory⁷, as a process that appears to proceed according to chance and hence is random even though its behavior is in fact determined by precise laws. For example, in the convection of water heated from below, if we sit on a single molecule or a cluster of molecules of water and chart its course as it goes from bottom to top and then comes back down, then we will see the picture as shown in Fig. 1(a). The water molecule is hit by other energetic water molecules and thus its motion is zigzag and very random. If we superimpose this picture on that for the next cycle then it will be like Fig. 1(b). If we do this thousand and millions of times then we develop a structure (or a band) in which the water flows from bottom to top as seen in Fig. 1(c). These are the convection cells or the dissipative structures.



Thus the random motion of these molecules evolves into a structure or convection current where majority of molecules flow through this band and seems as if they are “attracted” to it. In chaos theory these bands are called as “attractors”.

With increase in heating, which results in temperature rise (and ultimately the water comes to a boil), this structure changes shape and hence the water goes up more vigorously and with greater speed. Thus the structure is geometric, energy-dependent and dissipative in nature (dissipates heat) and is a function of the quality and quantity of energy input to it. The seemingly chaotically moving water molecules now have a definite path (convection pattern) in which they move.

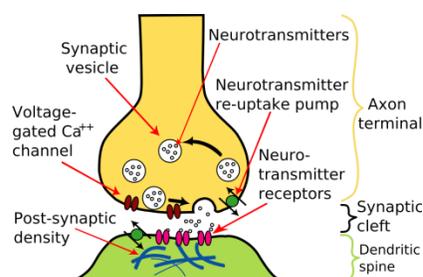
Both chaos theory and Prigogine’s dissipative structures have similar characteristics. They both show that in systems which are far from equilibrium and very chaotic, structures appear suddenly. These structures in the case of water are in four dimensions (three of space and

one of time). However, for a very large number of variables like a billion neurons firing in brain to produce thought, they could be in any number of dimensions greater than or equal to four. This idea is discussed in [greater details in next chapter](#).

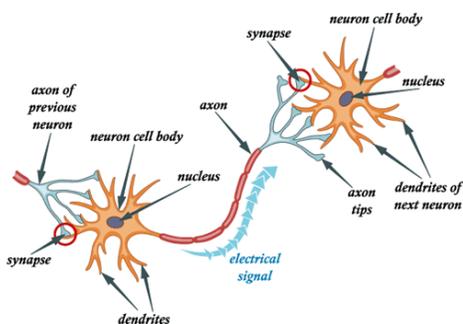
Production of Thought and its Structure

We can consider thought as a dissipative structure or an “attractor”. It is produced by the firing of a large number of neurons. How does such firing produce a structure called thought? But before we discuss it I will first try to show where the thought originates and then discuss its structure. I feel it originates in the synaptic cleft!

[Synaptic cleft](#) is a tiny space of about 20 nanometers (nm) between an axon and a dendrite and is the place where two neurons exchange information via [neurotransmitters](#) (NT).



A [neuron](#) has three parts. At one end is dendrite which accepts NT from other neurons; the central nucleus which is the heart of neuron and a long nerve fiber called axon whose end (synapse) releases the NT for transmitting to other neuron.



It is a generally accepted fact that a thought is produced when neurons fire. How many neurons fire for a single thought nobody knows. When a neuron fires it produces an electrical signal which is transmitted via the axon and at its end this signal gets converted into chemicals called NT. These NT pass through the tiny space of synaptic cleft and are

accepted by the dendrite of another neuron which converts them back into electrical signals before they reach the center of the neuron and the cycle continues. This is how the neural pathways are formed.

Why did nature produce this type of communication system where electrical signal from the neuron is first converted into chemicals (neurotransmitters) and again back into electrical signal?

A possible answer could be that during this conversion in synaptic cleft [photons are produced](#) which, I feel, are the signature of thought. This was corroborated when in [late 2010s Canadian scientists detected very low energy photons](#) (in far infrared region) were being emitted during the firing of neurons and transfer of neurotransmitters across the synaptic cleft. Scientists are still not sure in what way brain uses these photons but speculate that somehow they may help in increasing communication between various parts of the brain.

I conjecture that each photon production in synaptic cleft creates a feeble signal and when millions of such signals combine and superimpose on each other a thought signature results.

The [emerging science of Synchronization](#) might further help to explain it. This field emerged when it became possible to explain successfully how a very large number of fireflies start glowing in a synchronous manner in a short time after their random initial firing. Thus synchronization of fireflies glowing, heart cells beating (pace maker) etc. are all outcomes of a spontaneous order by which a large number of similar objects or oscillators work or fire in unison.

These oscillators synchronize spontaneously since they are influenced by each other via a positive feedback-type mechanism; in case of fireflies through their light signals. This feedback allows the oscillators to adjust their phases so that they synchronize.

Such synchronization of feeble photon signals at synaptic cleft might explain the emergence of a thought structure from a certain

portion of the brain. As one thought emerges and subsides (if not enough energy is provided to it), it is replaced by another thought emerging from another part of the brain and in this way the brain chatter takes place!

I also conjecture that this [thought structure is a hologram](#) and probably the reason why most of our thinking is geometric in nature and we seem to visualize everything in terms of shapes and geometry.

Since synaptic cleft plays a major part in thought production it is important that it is kept clean. It accumulates a lot of NT debris during the waking cycle.

The [cleaning of cleft takes place during sleep](#) when the cleft expands and the cerebrospinal fluid which floods the brain helps flush out the debris. With inadequate and disturbed sleep the cleft starts getting cluttered with debris. Sleep deprivation in the long run may lead to dementia and other mental disorders.

Memory resides in the neural pathways. With strengthening of synapses in these pathways strong memories and a powerful brain results. Such a brain produces wisdom and happiness. That is what [Patanjali has said in his Yoga Sutra](#).

The emergence of thought is a function of signals from sense organs or stimulation of certain memory space in the brain. However, [an entity called 'I' \(ego, will, sense of identity, etc.\)](#) acts like a symphony director and helps provide the necessary energy to maintain a given thought for a longer time. Besides it also provides coherence to random thoughts emanating from different parts of the brain. We still do not understand how 'I' can influence this process, but just like the music conductor who determines which part of the orchestra plays for how long, 'I' decides how long a particular thought will remain in the "vision" field. This process called concentration seems to also exist in animals.

With practice, concentration becomes stronger till a person can make nearly all the 100 billion neurons fire in a laser-like fashion for a long time on a single thought. This is the genesis of meditation or

Samadhi and with practice the deep thought hologram can be made so intense that it can ***transform suddenly from 4 - dimensional space to higher dimensions and may reside there as memory.*** [We will discuss in detail how this happens in Chapter 2.](#)

Concentration and Will Power

The ability to concentrate and to keep a single thought on a subject in the "vision" field for a long time is however unique to human beings because of our huge brain and memory size and is also governed by the will of a person. Yogis claim that will power is increased by continence. Recent scientific evidence suggests that the brain is full of sexual chemicals and their increased concentration in it helps in memory enhancement⁹. As memory increases so does the ability of concentration. Thus the desire to save these chemicals could be the basis of celibacy preached in almost all religions.

Concentration and will are related. With stronger will the [concentration increases](#) since we can force ourselves to focus on a single thought. Similarly as the concentration increases with practice a [person gains stronger will power since I or ego gets strengthened.](#)

Besides concentration, deep thought production could also be helped by drugs and application of electromagnetic (EM) fields to certain areas of the brain^{10,11}. Patanjali states that besides yoga, paranormal powers can also be obtained by the use of drugs¹². The drugs according to him help in concentration and hence in production of *Sanyam* and ultimately in getting powers. Hence ancient Indian Yogis knew the nature of brain and the effect of chemicals on thought. There are also innumerable examples of mind-altering drugs like LSD etc. which have created altered states of consciousness (including out of body experience) and have given powers of clairvoyance to the user as long as their affects last¹³.

Recently it has been discovered that sending a very weak current to the back of the right side of the brain triggered an out of body experience (OBE) for the patient¹⁴. This OBE could be produced at will whenever a particular part of the brain was stimulated by an electric current. OBE is one of the major outcomes of Yoga and is mentioned in the *vibhuti* (powers) section of Patanjali Yoga Darshan¹⁵. Naturally a yogi has to practice years of *tapasya* (spiritual practice) before he or she can achieve the OBE and sense of levitation. However technology seems to allow this pleasurable experience quite easily! For example altered states of consciousness in subjects have been induced by use of high-powered magnetic fields at different sites of the brain. This transcranial magnetic stimulation (TMS) is non-invasive and can be switched on/off at will¹¹.

Nevertheless both the chemical and EM techniques to enhance deep thought may produce short-term effects and may not be replicable. Besides the use of chemicals and drugs can produce dangerous side effects and may cause irreparable damage to the brain. Thus the surest method of producing replicable *Sanyam* is by sustained and willful practice of meditation and yoga. There is no shortcut to happiness!

Once the mind cultivates the habit of focusing on a particular thought for a long time, then the neural pathways for other thoughts subliminate and regroup to provide energy for this single thought. Because of the formation of new neural pathways, it is quite possible that earlier memory (Patanjali calls it *Sanskara*)¹⁶ can be dissolved and new memories can be formed. This is because a concentrated thought which is made stable for a long time requires more energy and neurons to sustain it and can only happen when the old memories are dissolved to free these neurons. Recent scientific evidence also suggests that the adult human brain is pliable and capable of creating new neural pathways and connections¹⁷. Removal of past memory by Yoga is a

mechanism for liberation (from cycle of birth and death) or *Kaivalya* and is a central theme in [Patanjali Yoga Darshan](#).

Some yoga methods nevertheless preach suppression of thoughts as a mechanism for removing memory. I feel these methods can never provide enough energy to break the existing neural pathways. Thus the suppressed memories always remain and sometimes come out with vengeance just like steam release from a pressure cooker. This is normally the case with suppression of sexual thoughts as preached by practitioners of this system. Thus the only way to remove the memory is via Yoga and *Sanyam*.

Use of deep thought on various subjects [has produced the greatest discoveries](#) of this planet. Einstein's relativity theory, Newton's gravitation theory and the truth revelations of Yogis and great spiritual leaders have all come because of their tremendous concentration and deep thought on their subject. It is a common utterance among scientists and lay persons that one particular person thought so deeply about a particular problem that Nature revealed her secrets to him. This *Sanyam* done on any particular idea or object leads to its complete knowledge or mastery over it. How deep thought produces knowledge is dealt in Chapter 2.

Deep thought also brings great joy and happiness to a person. The exhilaration that one feels in getting deep knowledge, creating new inventions or discoveries, is beyond any experience obtained through other human endeavors. Deep thought may help stimulate the pituitary gland and produce a sense of happiness. Our brains are somehow wired in such a way that we get a sense of well being when in deep thought. Maybe a union with the truth, super consciousness or God via deep thought is inbuilt in our system¹⁸. Hence understanding the structure of deep thought and its attributes can help mankind progress towards fulfillment and happiness.

Notes and References

1. Patanjali Yoga Darshan is the oldest book on Yoga. It shows in a scientific way how to control thought. There are four sections in this book. They are Samadhi (absorption), Sadhana (practice), Vibhuti (powers), Kaivalya (liberation). It has 195 sutras with each section containing about 40-50 sutras (Sutra is a Sanskrit word meaning a precise maxim). There are innumerable commentaries and translations of the Sanskrit book. Most of them are literal translations of the Sanskrit sutras which makes it very archaic and difficult reading. I have drawn extensively from the following books :
 - a. Swami Prabhavananda, *Patanjali Yoga Sutras*, Sri Ramakrishna Math, Madras, 1990.
 - b. B.K.S. Iyengar, *Light on Yoga Sutras of Patanjali*, Harper Collins Publishers India, 1993.
 - c. The interpretations of Patanjali's sutras are however mine.
2. fMRI uses radio waves and a magnetic field tens of thousands of times stronger than the earth's field to pick out variations in blood and oxygen supply to different tissues of the brain, which is highlighted in the image on the computer screen. There have been cases of many Yogis who refuse to be put under MRI machines saying that it interferes with their thinking. Ref. Laura Spinny, "The Mind readers", *New Scientist*, Vol. 175, No. 2361, 21 Sept. 2002, pg. 38-41.
3. The brain has about 100 billion neurons (the exact number is not known). Each neuron connects to other neurons via thousands of dendrites or axons. Thus the brain has a minimum of about 10^{14} connections to play with. The brain also has glial cells, which outnumber neurons nine to one. These cells can modify the neuron signals and with each neuron having its own firing characteristics, the number of permutations and combinations for memory formation are mind-boggling. Ref: R. Douglas Fields, "The Other Half of the Brain", *Scientific American*, Vol. 290, No. 4, April 2004, pg. 26-31.
4. Patanjali has described *Sanyam* as a combination of dhyana (meditation), dharana (concentration) and samadhi (complete absorption). When these three attributes are brought to bear on any object its complete knowledge results.
5. Concept of Dissipative energy structures was developed by Ilya Prigogine who got the Nobel Prize for his work on nonlinear thermodynamics in 1977. His two famous books are. (1) Ilya

- Prigogine, *From Being to Becoming*, W.H. Freeman & Co., 1980. (2) Ilya Prigogine and Isabelle Stengers *Order out of Chaos*, Flamingo, London, 1985.
6. The free convection in a fluid body heated from below produces hexagonal cellular structures. These structures were first observed by Benard in 1900 and hence they are called Benard cells.
 7. Edward N. Lorenz, *The Essence of Chaos*, University of Washington Press, Seattle, 1993.
 8. Steven Strogatz, *SYNC – The Emerging Science of Spontaneous Order*, Theia, New York, 2003.
 9. Brain is full of sexual chemicals like dopamine, serotonin, oxytocin, vasopressin etc. These chemicals help in increased neurotransmitter activity and memory enhancement. Good references are: (1) “I get a Kick out of you – The Science of Love”, *The Economist*, Vol. 370, No.8362, February 14, 2004, pg. 66-68. (2) Helen Fisher, *Why We Love: The Nature and Chemistry of Romantic Love*, Henry Holt and Company, N.Y., 2004.
 10. Stephen S. Hall, “The Quest for a Smart Pill”, *Scientific American*, Vol. 289, No.3, September 2003, pg. 36-45.
 11. Mark S. George, “Stimulating the Brain”, *Scientific American*, Vol. 289, No.3, September 3, 2003, pg. 46-59.
 12. Ref.1, Sutra IV. 1.
 13. Out of body experience; www.fact-index.com/o/ou/out_of_body_experience..html
 14. Olaf Blanke, *et.al.*, “Stimulating illusory own-body perceptions”, *Nature*, Vol.419 , 19 September 2002, pg. 269.
 15. Ref.1, Sutra III. 39.
 16. Sanskar is a Sanskrit word meaning subliminal impressions or memory.
 17. Joshua T. Trachtenberg et al. “Long-term in vivo imaging of experience-dependent synaptic plasticity in adult cortex”, *Nature*, Vol. 420, 19/26 December 2002, pg. 788-794. Also Ole P. Otterson and P. Johannes Helm, “How hard wired is the brain?”, *Nature*, Vol. 420, 19/26 December 2002, pg. 751-752.
 18. Andrew B. Neuberg, *Why God Won't Go Away*, Ballantine Books, 2001. The basic finding is that human brain is hard wired for religion and is set up in such a way as to have spiritual and religious experiences.
 19. Anil K Rajvanshi, “Where in the Brain thought originates?” <https://nariphaltan.org/thoughtorigin.pdf>

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