Chapter 2

LITERATURE

SURVEY
2. Literature Survey

A comparative study of how perception and thoughts influences gene expression (from current as well as ancient texts)

2.1 Concept of Heredity, DNA, Genes and its functions:

“Like begets like” and “chip of the old block” are two of the adages quoted often when we come across a situation to compare parents and children. These popular adages are indeed so commonplace that we may not be able to appreciate the complete truth behind it. Indeed why should a human being give birth to another human being and not any other organism. A mango seed sown in the soil produces only a mango tree and not a guava tree. What is it that is hidden inside the mango seed that makes it grow into a mango tree only. When children are born we often hear statements like “the nose is like the father’s and the eyes are like the mother’s but the hair and the mouth are different”. This is shows that the new born in addition to having parental characters, has its own characters too. Again what is a mystery behind the fact is that, the child has sufficient similarity with the parents and yet sufficient differences also. (Bateson, 1906)
Genetics is a branch of biology that aims to find the answers to the above questions. In fact genetics is still trying to unravel the total mystery behind these very common statements. Even though most of the basic facts have been unearthed there still remain more unsolved questions and still more remain in the darkness of the unknown.

Organisms are capable of transforming their characters to their next progeny as a result of reproduction. Ever since life first arose on this earth, it has maintained itself today in myriad form only due to its capacity to reproduce. Until 1868 when Mendel working with pea plants came out with a convincing explanation regarding the mechanisms of heredity, it was largely speculative as to how organisms pass on their characters to their progeny. The term genetics was first used in 1906 by Bateson. Earlier to this the science of genetics had already made its firm beginnings from Mendel’s epoch making work with pea plant. The rediscovery of Mendel’s work individually by other scientists paved the way for founding the science of genetics. The term ‘genetics’ was coined in 1906 by Bateson. Mendel speculated that our cells carry hereditary units which was later termed as Genes by Waldyene in 1937.
Figure 2.1. DNA Molecule

Figure 2.2. Showing a schematic diagram of functions of DNA.
DNA is a highly complex molecule manufactured in the cell nucleus and serves as the cell's "brain." DNA is the blueprint for everything the cell does. Nucleic acids are the basis of all life forms on earth. The Deoxy-ribonucleic acid or the DNA and Ribonucleic acid or RNA is the blueprint of all life on earth. The DNA is a chemical compound which consists of a Deoxy Ribose Sugar a phosphate backbone and fours types of Nitrogenous bases. The bases (Adenine Guanine cytosine and thymine) are linked in a pattern. In a human cell, the DNA is arranged in 46 distinct sections called chromosomes. They are arranged in pairs, 23 chromosomes from each biological parent.

Together, the 46 chromosomes contain more than 40,000 genes. (Sanger UK update 2005). A gene is a segment of DNA that determines the structure of a protein, which is needed for development and growth as well as carrying out vital chemical functions in the body. (Watson et al 1953). Like the chromosomes, genes are arranged in pairs - one gene from the mother and one from the father.

There are 3.4 billion such bases which are linked in two helically coiled chains to form a double helix structure. In these vast sea of DNA
sequences there are few islands of meaningful sequence which functions or transcribes into RNA are called as **Genes**. (Kornberg, Molecular cell, 1978.)

Each gene occupies a specific location on a chromosome. Through a number of biochemical steps, each gene signals a cell to make a different protein. Some genes instruct the cell to manufacture structural proteins, which serve as building blocks. Other genes signal the cell to produce hormones, growth factors or cytokines, which exit the cell and communicate with other cells. Still other genes tell the cell to produce regulatory proteins that control the function of other proteins or tell other genes when to turn "on" or "off." When a gene is turned on, it transcribes another complex molecule called ribonucleic acid (RNA), which contains all the information the cell needs to make new proteins. **Central dogma**

Originally proposed by **F.H.C.Crick** in **1956**, the Central dogma of molecular biology states that genetic information flows uni-directionally from DNA through RNA into protein. The biosynthesis of proteins is under the direct control of DNA in most of the cases or else under the control of the genetic RNA where DNA is absent. The information for the structure of a polypeptide is stored in a polynucleotide chain. The
sequence of bases in particular segment of polynucleotide chain will
determine the sequence of the amino acids in a particular polypeptide.
This relationship is particularly known as Central dogma.

Cells divide only when they receive the proper signals from growth factors
that circulate in the bloodstream or from a cell they directly contact. For
example, if a person loses blood, a growth factor called erythropoietin
which is produced in the kidneys circulates in the bloodstream and tells
the bone marrow to manufacture more blood cells. (Molecular biology of
the gene, Watson 1971.)

The understanding of the structure of a simple molecule, the DNA, stood
at the gateway of a new field of study called genetics. Further more
discoveries in the field of psychology; however, has added more
understanding of life. In the current world there is a growing need to
expand the understanding of this process of life. The researchers have
realized that by localizing, any study of life does not lead to the proper
knowledge and thus there is a cross talk between the studies to bring about
a comprehensive understanding of life.
2.2. The process of perception and memory:-

Incoming visual stimuli are converted into neural signals by the retina and transmitted to the primary visual cortex. Often these visual stimuli are preserved in temporary memory traces so that the information is available for use for a few seconds after the stimulus is gone. The primate visual system has evolved two distinct pathways for serving this kind of visual memory. One is a dorsal pathway for spatial memory (the "where" pathway), and the other is a ventral pathway for object memory (the "what" pathway). The dorsal pathway carries visual information specialized for spatial location from the visual areas through the parietal cortex and to the dorsal lateral prefrontal cortex; in the monkey brain, this latter region is just anterior to the frontal eye field. The ventral visual memory pathway carries parallel information, specialized for object recognition, from the visual cortex through temporal regions and on to the middle and inferior frontal cortex. (Courtney et al 1999).

2.2.1 Mechanism of perception:-

Regulation of Ion Channel Function in CNS Neurons

CNS neurons express a variety of ion channels with specific roles in the generation and regulation of neuronal properties and functions.
Transmission of neuronal signals is similar to electrical signalling. The ion channels which are operated by mainly Calcium and Potassium ions facilitate the conductivity of nervous signals. Of particular importance are the **voltage-gated calcium channels** (VGCCs). Although several types of these channels are expressed by neurons, calcium signaling through L-type VGCCs is particularly important in many fundamental neuronal processes, including neuronal development, neuronal excitability, and calcium homeostasis.

Extensive studies of VGCCs in cerebellar Purkinje neurons from adult animals, a neuronal type that plays a critical role in fine motor control, have indicated that the channels are essential for **dendritic excitability**. The primary VGCCs involved in this function are the **P/Q-type VGCCs**, which are expressed in abundance in Purkinje neurons. Recent immuno-histochemical studies revealed that in addition to P/Q-type VGCCs, Purkinje neurons express **L-type VGCCs**, both in the mature state and at early stages of development. In the mature neurons, the L-type channels were located primarily in the somatic region, whereas the P/Q-type channels were prominent in both the somatic and the dendritic regions. *(Gruol, D et, al 2006)*
To examine the role of L-type VGCCs in Purkinje neurons, Gullette and his group used combined recordings of intracellular calcium and electrical activity in cultured Purkinje neurons at different developmental stages. The results showed that L-type VGCCs contribute to somatic excitability and calcium signaling both early in development, when each Purkinje neuron consists of just a soma and fine peri-somatic processes, and at mature stages, when dendrites are present. Interestingly, L-type VGCCs played a prominent role in the somatic excitability of Purkinje neurons. (Gullette, et al 2006).

2.2.2. Events that lead to memory

Memory stores patterns of activity in modular form in the brain's cortex. Different modules in the cortex process different kinds of information - sounds, sights, tastes, smells, etc. The cortex sends these networks of activity to a region called the hippocampus. The hippocampus then creates and assigns a tag, a kind of temporary bar code that is unique to every memory and sends that signal back to the cortex. (Bruce McNaughton 2007)

Each module in the cortex uses the tag to retrieve its own part of the activity. A memory of having lunch, for example, would involve a number of modules, each of which might record where the diner sat, what was
served, the noise level in the restaurant or the financial transaction to pay for the meal.

But while an actual dining experience might have taken up an hour of actual time, replaying the memory of it would only take 8 to 10 minutes. The reason, McNaughton said, is that the speed of the consolidation process isn't constrained by the real world physical laws that regulate activity in time and space.

The brain uses this biological trick because there is no way for all of its neurons to connect with and interact with every other neuron. It is still an expensive task for the hippocampus to make all of those connections. The retrieval tags the hippocampus generates are only temporary until the cortex can carry a given memory on its own.

"It's a slow process," according to McNaughton.

"The initial creation of the tag is made through existing connections. In order to do the rewiring necessary to have the inter modular connections carry the burden takes time. What you have to do is reinstate those memories multiple times. Every time you reinstate the memory, the modules make a little shift in the connection. Something grows this way, grows that way, a connection gets made here, gets broken there. And eventually, after we do this multiple times, then an optimal set of connections gets constructed," McNaughton said.
The brain is generally thought to do all of this during sleep, specifically slow-wave sleep, when the brain is not busy with processing real-time inputs. McNaughton has developed the technology to record from multiple probes, each of which can track the activity of a dozen or more brain cells. McNaughton said that" We need groups of cells because in order to identify a pattern, we have to look at the collected activity of many neurons,". His previous research has showed that cells that fired during activity prior to sleep, also fired in the same sequential patterns during sleep. During sleep, the hippocampus sends little, 100-millisecond bursts of activity to the cortex as much as three times per second.

2.3. Emotional Memory and its Impact on Genes:-

The Swiss study by: John Timmer et al 2007 *(Nature Neuroscience, 2007)*

It has been known for a long time that humans can remember those things that have an emotional impact, whether positive or negative, far better than we can recall neutral items and events. Drug studies have suggested that the noradrenergic signalling system is essential for this process. The
research team involved in a new work recognized that a gene for one of the receptors in this signalling system of adrenergic receptors of alpha 2 beta G protein receptor family \((ADRA2B)\) exists in two forms. Chemically, the two forms differ by the presence or absence of three amino acids in a section of the protein that has a large negative charge. In the US, about 30 percent of Caucasians and 12 percent of African-Americans have the shorter form of the gene.

The researchers tested a set of over 400 Swiss volunteers for their ability to recall emotional content. The test subjects were genotyped to determine what form of the \(ADRA2B\) gene they carried, and then given sets of photos to examine from a standard set of images with positive, negative, and neutral emotional content.

Their genotype made no difference to their ability to evaluate the emotional content of the image. But it had a huge impact on their ability to recall the image 10 minutes later. Those with the short form of \(ADRA2B\) gene had nearly double the recall ability, with success rates rising from the low 40 percent range up to just short of 80 percent. Recall of neutral images was unaffected.
The authors noted that the ability to recall things associated with feelings of danger or safety could provide a huge selective advantage in evolutionary terms. But they also considered the possibility that there could be too much of a good thing: excessive recall of disturbing events appears to be at the root of post-traumatic stress disorder. They worked with a Ugandan researcher to check how the \textit{ADRA2B} variation affected survivors of the Rwandan genocide. Recall of traumatic events was higher in those carrying the short form of \textit{ADRA2B}. (Timmer \textit{et al, 2007})

\textbf{2.4. Depression and Mood Regulated Neuronal Signalling}

\textbf{The John Hopkins study on Rats, 2006}

In an experiment, Li Jun Zhou and his team at the Johns Hopkins University School of Medicine found that rats after injected with Prozac (anti-depressant) did not merely experience a change in their brain chemistry but also grew new nerve fibres in mood-critical areas of the brain. Through intricate staining techniques, the Hopkins team found that rats treated with Prozac(anti depressants) grew more axons- in the neural branches that send messages- on serotonin-sensitive neurons in cortical and forebrain areas crucial to mood. Lijun Zhou, a researcher in neurosurgery, proposes that this local change is "the key structural effect
of serotonin antidepressants" and may help explain some successful antidepressant therapy. In this study it was proved that prolonged depression causes degeneration of nerve fibres resulting in dead areas in the brain. The neurotrophin levels are directly related to the mood of a person and mood elevators can cause permanent growth signalling in the brain. Therefore, now scientists are proving the rational that mood swings can result in dramatic change in gene expression and neuronal growth profiling.

2.4.1. Stress Signalling and Gene Expression:-

O. Krizanova et al 2002 reported that repeated stress (Immobilisation) reduces the gene expression of the type 1 and 2 IP₃ receptors in satellite ganglia in mice.

Inositol 1, 4, 5-trisphosphate (IP₃) is one of the second messengers produced by phosphoinositid hydrolysis and triggers IP₃ receptor (IP₃R) mediated calcium release from intracellular pools. In another work Bary et al 2002 at Harvard reported that psycho stimulants and prolonged stress influence the gene expression profile of L- type calcium channels and affects neuronal signalling.
Figure 2.3. The above schematic diagram represents the effect of perception and thought at various levels and how it leads to memory.

Another study by Stevenson et al 2005 shows that shortages of neurotrophin may contribute to the original structural weakening of neural-network circuit. According to the authors, neurology is deeply affected by perception and our perception deeply affects our neurology. We pause between thought and actions as the segment of time that allows us to feel something we call will (that half-second in which we can either stop or allow the action to take place). But what if the time it
takes our thoughts to cascade into action is reduced by other means than what naturally occurs - perhaps by drug therapy that makes thought-into-action far more efficient? Does this mean that the feeling I have of Will becomes only the fleeting illusion of Will? Might conditions like ADD (Attention deficit Disorder and ADHD Attention deficit hyperactive Disorder is nothing more than too little time available for individuals between thought and action? This is the most important mystery as to how thoughts are converted into action and where are the controlling switches located. Are they in the neurons or in mind which is a non-biological entity? Probably the best solution is from the Mind to the *prana*(pancha prana) level and then to the body level which are neurons.

2.5 Perception and their influence on tendencies according to ancient texts:-

2.5.2. Law of the Last Thought according to Bhagavat Gita:-

आ नो भद्रह क्रतवो यन्तु

ā no bhadrah kratavo yantu

*Let noble thoughts come to us from every side*

*Rig Veda 1-89-1*
The theory of last thought.
अन्तकाले च मामेव स्मरन् मुक्त्वा कलेवरम् ।
यः प्रयाति स मद्यावं याति नास्त्यत्र संशयः॥
Antakāle ca māmeva smaranmuktvā kalevaram
yah prayāti sa madbhāvam yāti nāstyatra saṁśa ayah (BG ch-4;5)

Translation:-
He who departs from the body thinking of me alone even at the time of
death attains my state, there is no doubt about it.

यं यं वापि स्मर न् भावं त्यजत्यन्ते
कलेवरम् ।
तं तमेवैति कौन्तेय सदा
तद्भावाभावितः॥
yarñ yarñ vai pi smar na bhavam tyajyante kalevaram
tari tamevaiti kaunteya sadā tadbhāvabhāvitaḥ (BG ch-4;6)

Translation:-
Thinking of what ever entity one leaves the body at the time of death that
and that alone attains being ever absorbed in its thought.

We might think that, according to the common belief, a man is reborn
according to his thoughts at the time of his death. How, then, can this
belief be reconciled to the theory that the rebirth is caused by the
unfulfilled desires to be fulfilled in the next life? The ideas and the
thoughts which come at the time of the death of a man are responsible for
his next life. But, at the same time, the Vedānta asserts that at the time of
death only those thoughts and desires come to mind, which were most
dominant during the life of the man. Here we get an explanation of how
our life long accumulated thoughts in our permanent memory influence
the behaviour and our intense desires. There is a biological programming
behind these thought processes. Therefore, only rare few people think of
God at the time of their death. The rest of the common people are always
engrossed in their thought and vāsanās which entangles their sūkṣma
śarīra. Life is a mix of good and bad. We induce good or bad tendencies
(vasanas) in our life depending upon our good or bad karmas. Each karma
(action), or thought leaves a residual impression or Vasana (a Sanskrit
word which means the fragrance of food that is left in the cooking vessel
even after it is washed) in our mind. Only yogis of high order, who
practice niskāmā Kārmā, are free from the effects of their actions.
The Vasanas of our actions become tendencies of our personality
including us to repeat the same action again and again and, thus, forming
habits which become our typical characteristics. Impressions, the root
cause of all the desires and resultant actions, accumulated over many birth
from stock of our karmas, both good and bad (and mixed) called Sanchita
Karma. Vasanas are superficial temporary memory patterns and they
become samskaras and they become Samskaras which can be designated a
personalitry features by long term memory stores.
vasanās are like the seeds that have to fructify or manifest (abhivyakti) according to the favourable circumstances (anugunanam) at appropriate time (vipaka). Our psyche is a very fertile land. Nature is very kind to allow each and every seed to sprout.

This vasana has to fructify itself according to the environment and fruitful conditions. Swami Sivananda (chittaśudhī 1971) has said if we do any kind of work, it produces an impression in the subconscious mind or Citta. This impression is called Saṁskāra or tendency. Whatever you see, hear, feel, smell or taste causes Saṁskāras. The acts of breathing, thinking, feeling and willing produce impressions. These impressions are indestructible. They can only be fried in toto by Asamprajñāta Samadhi. Man is a bundle of Samskaras which are impressions. It is these Saṁskāras that bring a man again and again to this physical plane. They are the cause for rebirths. These Saṁskāras assume the form of very big waves through memory, internal or external stimulus. (Swami Śivananda, 1971)

It is these tendencies that a man is born with again. Even the genome it selects is governed by the last thought and the saṁskāras or the karmic
signatures of the life lived before the death. Even the Rig-veda asserts that
let noble thought come from all sides.

2.5.3 Concept of Guṇas and tendencies according to Bhagavat Gīṭa.

The three gunas of Sattva, Rajas and Tamas born out Prakriti bind down
the immortal soul to the body it its embodied state.

The Tamas Guna is ignorance- born and is the product if delusion in all
beings. It is characterises negligence, indolence and sleepiness. It is this
Guna which is the cause of all delimas worries tension and violent
emotions.
Those established in sattva evolve to higher goals while those abiding in Rajas remain in the mid-course. Steeped in evil tendencies the Tamas dominated one degenerate.

According to Bhagavadgīta, in the eighteenth chapter, Bhagavān Sri Kṛṣṇa says that there is nothing, either on earth or in heaven, which is not controlled by the guṇas. Right from the bottommost hell to the topmost heaven, we will find that everything is constituted of, controlled and regulated by the guṇas.
Bhagavan speaks

Of the three basic attributes (Gṛṇas)

(Similar to the three basic forces of nature)

Rajo -guna is the one, which imparts motion

And is the origin of Kaama, the basic source

For anger and/or other desires,

This karma is the one that

You have to know and master

Because this basic karma

Is the real root cause of all problems.

And can be seen as a foe for all human kind. ||BG Ch 3:37||

Even the mind is under subjection to the operation of the gṛṇas. The mind is nothing but the gṛṇas in a subtle form. A rarefied form of the gṛṇas is the substance of the psychological organs - manas, buddhi, ahaṅkāgunas rā, citta - the mind, the intellect, the ego and the subconscious. A gross
form of the same guṇas appears as the five elements - earth, water, fire, air and ether. Therefore there is a fraternity of feeling between the mind inside and the object outside, since both of these are constituted of the same guṇas, as it has already been. One of three Guṇas is generally predominant in different men. A Sāttvic man is virtuous. He leads a pure and pious life. A Rajasic man is passionate and active. A Tamasic man is dull and inactive.

*Sattva* makes a man divine and noble, Rajas makes him thoroughly human and selfish, and Tamas makes him bestial and ignorant. There is much *Sattva* in a sage or saint and more *Rajas* in a soldier, politician and businessman.

Limitation of Rajas is excesses. These excessive functioning changes the balance of the three Gunas and leads to stresses at mental levels. Cancer is also the result of excessive functioning of the genes which promotes uncontrolled growth in cancer.

2.5.4. Nature and nurture and the functional duality of environmental Conditions for Karma

प्रकृते गुणसम्मूढः सज्जनते गुणकर्मसु ।
तानकृत्सविदो मन्दान्कृत्सनविन्न विचालयेत् ॥
Translation:-

They are under the influence of the guṇas of the pṛṇi (They do not know it) they are attached, They should not be disturbed by the ones who know it fully they should not be confused by the ones who have reached the center of the tendencies produced by these three kinds of karma (icchā, anicchā and parecchā), (personally desired, hatred or not desired or due to other desires only those are manifested for which the conditions are favourable. Because of our memory of past tendencies, the chain of cause and effect is not broken by change of species, space, or time Good and bad sarīṇskāras are like seeds of different plants kept in a bottle: some grow in winter, some in the summer, and some in the rainy season. If we throw all the seeds on the earth, the seed which grows in that season will grow and the others will remain dormant waiting for the suitable environmental stimuli is also same in basic genetics (Mendel 1896). If a pea plant with wrinkled seeds is sown it gives rise to the same morphological seeds. The seeds which nee optimum temperature to grow and Ph shall grow only in those conditions other wise it waits for the optimal conditions to be furnished. It can be also correlated with the daily life styles and stress accumulated during our course of life time. Thos thoughts which are
converted into permanent memories are expressed if/when given suitable stimuli. (Goud et al., 2004).

2.5.5 Intellect and its controlled function (the power of discrimination)

तत्त्ववित्त महाभो हो
गु णकेश विभागयो: ॥
गुण गुणेषु वर्तन्त इति मत्वा न सज्जते ॥

tatvavittu mahābhāho
guṇ a-karma-vibhāgayoh
guṇā guṇeṣu vartanta
ti matvā na sajjate (BG ch 3.28)

But they mahābhāho (Arjuna)

Those steady ones that really understand

The divisions of Karma and that of Guṇas (attributes)

Guṇas abide in guṇas

Understanding thus, the wise ones

Remain always unattached.

What is happening, is happening, is happening

Let it be, let it be, let it be

The intellect or the Buddhi is the most important of all the products of Prākṛti. The senses present their objects to the intellect. The intellect
exhibits them to the *Puruṣa*. The intellect discriminates the difference between *Puruṣa* and *Pṛkṛiti*.

**Figure 2.4.**

**Concept of yoga**

- **Animals**
  - Ahara - food
  - Nidra - sleep
  - Bhaya - fear
  - Maithuna - procreation

- **Human**
  - Ahara
  - Nidra
  - Bhaya
  - Maithuna

The intellect is the instrument or organ which is the medium between the other organs and the Self. All ideas derived from sensation, reflection, or consciousness are deposited in the chief or great instrument, intellect, before they can be made known to the Self for whose use and advantage
alone they have assembled. They convey impressions or ideas with the properties or effects of pleasure, pain and indifference, accordingly as they are influenced by the qualities of Sattva (purity), Rajas (passion) or Tamas (darkness)

2.6 According to Sage Patanjali:-

2.6.1. हेतुपलाश्रयालाम्बने: सञ्गीतत्तत्त्वादेशामभावे तदभावः ||
hetuphalāśrayālāṁbanai saṅgītataḥ ādese āmabhāve tadabhāvaḥ (YS4.11)
Translations:
Cause, consequence, mental colouring, and object support are interdependent, and when they disappear, desire ceases to manifest.
These tendencies are both maintained and sustained by misapprehensions, by external stimuli, by attachment to the fruits of actions and by the quality of mind that promotes hyperactivity. Reduction of these automatically makes the undesirable impressions ineffective.

2.6.2. PYS4.3
निमित्तमप्रयोजः कं प्र कृतीनां वर्णभेदस्तु तत्तः क्षेत्रिकवत् ||
nimittamaprayojakarṇaḥ prṛ kṛ tīṁaṁ varṇaḥ abhedastu tataḥ kṣetrikavat
Translational:

The causes of evolution do not set nature in motion, but withdraw obstacles, like a gardener opening an irrigation canal.

But such intelligence can only remove obstacles that obstruct certain changes. Its role is no more than that of a farmer who cuts a dam to allow water to flow into the field where it is needed.

2.6.3. तत्त्वे रूपुष्क्यात्तेमुक्तेवतृष्णायम् ॥

tatparaṁ puruakyātṛtuṁ avaiṭṛṣṇaṁ yaṁ (PYS: I.16).

In respect of the practice of vairāgya, about which we have been studying up to this time, Patanjali says that real vairāgya cannot arise unless we gain freedom over the guṇas. The spirit of renunciation does not get confirmed and does not become steadfast merely by a readjustment of an outward attitude towards things. What is essential is an adjustment of inward tendencies, and if the tendencies persist, our outward adjustments will not be of much consequence, because what liberate us and what binds us is the tendency inside, and these are the guṇas. These guṇas are terrific forces, and they cannot be controlled by ordinary effort. They are terrific because they are our masters. We are entirely made up of them, and we are subjected to them in every sense of the term. Every fibre of our being is
nothing but the guṇas. This is actually the difficulty of self-mastery. The mastery over the guṇas is mastery over one’s own self

2.6.4PYS4.27

tacchidreṣu pṛtyayāntarāṇi saṁskārebhyaḥ

Any gaps in discriminating awareness allow distracting thoughts to emerge from the store of latent impressions.

In the intervening spaces of that, there are other intentions, due to saṁskāras.

2.6.5. Perception of thought in alert mind according to Patanjali.

Guru Patanjali says that on the cultivation, disciplining and perfection of seeded spiritual union, a perfect disciple attains spiritual technology of discrimination. Awareness of this technology about the distinction between the alert mind, which is a product of Nature, and self which is a product of soul starts getting experienced. The perfect disciple starts truly and visibly experiencing the existence of a conjunction between spiritual technology of self and Nature’s lack of spiritual technology and self-
sense. It is due to this conjunction that the alert mind exists. The existence of the alert mind is due to the presence of this conjunction.

It is on the breaking of this conjunction between the alert mind and the self, that the alert mind gets eliminated. Self, however, is eternal and is a real viewer and a seer. The alert mind is merely a servant. It takes cosmic energy from self in order to function and operate. The alert mind is a cosmic instrument, which by taking energy from self, performs functions in order to serve its sovereign master, the self. The soul’s self is a mere viewer and a seer. It does not perform any action. It does not also enjoy any action. It does not harbour any craving or any thought. The flow of lingering past subliminal impressions and the flow of craving for action, takes place in the depth of the alert mind alone. The enjoyment of worldly subjects and objects like before, however, keeps ongoing in the lingering past subliminal impressions due to the seed of the fear of death. It is in this state that on the one hand the alert mind takes the self -alert towards the soul and then takes it to a state of isolation. On the other hand and due to the presence of the seed of fear of death, it fears that by doing so the alert mind itself would die. As such, alert mind runs after the enjoyment
of worldly pleasures. It keeps its own self-sense intact under all circumstances.

The Great Sage says that in the state of isolation the alert mind has to perform two functions. On the one hand, remaining lingering past subliminal impressions for the enjoyment of subjects and objects has to be fulfilled and enjoyed. On the other hand, self-alert has to be taken out of the grip of lack of spiritual technology of Nature’s essence or reality. Due to these two causes and due to the fear of death lurking in the lingering past subliminal impressions, the state appears as a death like state to the perfect disciple. The fear of death is in the form of a mere seed in the lingering past subliminal impressions. It is in the form of a mere memory.

2.6.6.

tatstadvipānugunāmevaśīvaktaṁ
śāsanānaṁ

tatstadvipānugunā mevābhivyaktirvāsanānāṁ (PYS4.8)

Translations:
Consequences surely follow these inappropriate tendencies.

Because the tendency of the mind to act on the basis of the five obstacles, [avidyā (ignorance), (ii) asmitā (egoism), (iii) rāga (attachment), (iv) dveṣa (hatred) and (v) abhiniveśa (fear of death)]. They will surface in the future to produce their unpleasant consequences.
2.6.7. Interaction between the Guṇās Leads to Evolution.

YS 3.22
सोपक्र मं निरुपक्र मं च कर्मे
तत्संयमादपरान्ततज्ञानमरिष्टेभ्यो
वा ॥
sopakramaṁ nirupakramaṁ ca karma tatsāṁyaṁād- 
parāntajñamarih ś tebyo vā

Translations:

Perfect mastery of slow and rapid evolution of actions brings knowledge 
of the time and circumstances of one's own death. This is also known 
through premonition.

The results of actions may be immediate or delayed. Saṁyama (voluntary 
control) on this can give one the ability to predict the course of future 
actions and even his own death.

Karmas are of two kinds; quickly manifesting and slowly manifesting.

The three Guṇas are never separate. They support one another. They 
intermingle with one another. They are intimately related as the flame, the 
oil and the wick of a lamp. They form the very substance of Pṛkṛti. The 
Guṇas act on one another. Then there is evolution or manifestation.

Destruction is only non-manifestation.
Translations:
Positive evolution is the result of one's innermost nature. Change from one set of characteristics to another is essentially an adjustment of the basic qualities of matter.

2.6.8. Concept of mind according to Sankhya (kapila muniolest of the six systems of Indian philosophy).

There is no separate Praṇa Tattva in the Sankhya system. The Vedanta system has a separate Praṇa Tattva. In the Sankhya system, mind, with the organs, produces the five vital airs. Praṇa is a modification of the senses. It does not subsist in their absence.

The Guṇas are the objects. Puruṣa is the witness-subject. Prakṛti evolves under the influence of Puruṣa. Mahat or the Great (Intellect), the Cause of the whole world, is the first product of the evolution of Prakṛti. Ahankāra arises after Buddhi. Agency belongs to Ahankāra. It is the principle that creates individuality. Mind is born of Ahankāra. It carries out the orders of the will through the organs of action (Karma Indriyas). It
reflects and doubts (Sankalpa-Vikalpa). It synthesises the sense-data into percepts. The mind takes part in both perception and action.

From this Pṛkṛiti emanates the cosmic Buddhi or Mahat. From Mahat proceeds the cosmic Ahankāra or the principle of egoism. From this egoism emanate the ten senses and the mind on the subjective side, and the five subtle Tanmatras of sound, smell, taste, colour and touch on the objective side. From these Tanmatras proceed the five gross elements - earth, water, fire, air and ether.

During dissolution of the world, the products return by a reverse movement into the preceding stages of development, and ultimately into Pṛkṛiti. Earth merges in its cause, water, water in fire, fire in air, air in Akasa; and Akasa in Ahankāra, Ahankāra in Mahat, and Mahat in Pṛkṛiti. This is the process of involution. There is no end to Samsara or the play of Pṛkṛiti. This cycle of evolution and involution has neither a beginning nor an end.
2.6.9 Memory and its impressions:

**PYS 4.8 अनुभूतविषयासम्प्रमोषः स्मृतिः**

anubhūtaviṣṇ ayāsapramoṣaḥ smeṣ tiḥ

*Translations:*

Memory retains living experience. Memory is the mental retention of a conscious experience. Memory is the "non-deprivation" [i.e. retention] of experienced objects.
Recollection is mental modification caused by reproduction of the previous impression of an object without adding anything from other sources. Memory is the not stealing away along with objective mental impression [retained] [i.e. the reproducing of not more than what has been impressed upon the mind. When a mental modification of an object previously experienced and not forgotten comes back to consciousness that is memory. Memory is not allowing an object which has been experienced to escape.

Our memory is intimately linked with emotion and it is very subjective. "Memory is knowledge born out of samskàra." Once a memory has been laid down, it can surface at any time when rekindled for some reason. A memory can be of something real or something imagined; the latter is what happens in dreams” All memories arise out of impressions whether of right cognition, misapprehension, vague ideation, deep sleep or of former memory. The foregoing fluctuations are of the nature of pleasure, pain or afflictions.
Every living being, be it a mighty elephant or a tiny insect, runs to save its life when any danger is perceived. Where do this knowledge and the fear of death come from? We generally learn things by experience. But living beings do not have this experience of death. As per Hindu thoughts, this experience of death may not have occurred in this life but is a behaviour learnt in previous lives and inherited as *sañskāras*

**Translations:**

Despite differences in birth, place and era, our behaviour continually perpetuates itself because of the unity of form between memory and mental permeation.

Memory and latent impressions are strongly linked. This link remains even if there is an interval of time, place or context between similar actions.
Sensory perceptions and attractions from the external world are the basic stimulants to provoke the external reactions. If the sensory perceptions get converted into attractions there should be some screening arrangements in the brain, which will let through only some of the perceptions, which can become attractions. Memories must obviously play an important role in this screening process. Prātyāhāra is the process of vitally activating this screening process, and make it so scrupulous that the real core of the mind is left free to take on its fundamental function, which is the realization of ānanda.

Here Patanjali explains that there is a programming in the brain after the perception thoughts and memory. But Yoga is the trick to modify the process and remain detached from the impressions. The process has to be
voluntary and not forced. The withdrawal must come from the innermost efforts of the mind in a gentle manner.

2.7. FROM THE UPANIŚADS:

Beginning our search in the upaniṣads, we start from the most profound and smallest of the upaniṣads-

2.7.1. Māndukyopaniṣat.

नान्तः प्रज्ञं न बहिष्प्रज्ञं नोभयतः प्रज्ञं न प्रज्ञानधनं न प्रज्ञं

नाप्रज्ञम् ||

अदृष्टमेवहायेऽमग्राह्मलक्षणमचिन्त्यमध्यपदेशयमेकालमप्र

t्यसां प्रपञ्चोपशांशान्तेषु शिवमेवैतं चतुर्थं मन्यन्ते स

आत्मा स विज्ञेयः ||

Nāntaḥ prajñāṁ na bahiṣ prajñāṁ nobhayataḥ prajñāṁ na
prajñānagahanāṁ na prajñāṁ nāprajñāṁ |

Adṛṣṭāḥ amavyahāryamgraḥyamakṣaṇaḥ amacintyamavyapadesyamekāḥ
mapratyaśāraṁ prapañcospaṁ śaṁtaṁ śivadvaitaṁ caturarthaṁ

manyante sa ātmā sa vijñeyaḥ (Māṇḍūkya Up : 7)

_Cognitive (wakeful) nor cognitive bothwise (intermediate state in between wakeful and dream states); neither is it an indefinite mass of cognition (deep sleep), nor collective cognition (Īçvara’s cognition of whole_
The phenomenal existence in one) nor non-cognition (mere insentient act). It is unseen, unrelated inconceivable, uninferable, unimaginable, indescribable.

It is the essence of one’s Self, a cognition common to all states of consciousness. All phenomena cease in it. It is peace, it is bliss, it is non-duality. This is the Self and it is to be realized.

There is a very subtle hint and advice given here to the humanity or the students of Indian spirituality. The cognition or the thought processes after perception must be let go or subliminally filtered so that it does not leave any lasting impressions by which we are attached. We must therefore, have only the ISvara impressions which is the basis of the creation and freedom in the cosmos.

2.7.2. As per Kaṭhopaniṣat:

In Kaṭhopaniṣat we read the lines as follows:

यदा सर्वं प्रमुच्यते कामा येस्या हृदिः श्रीता ।
अथ मत्यांस्मृतो भवत्यत्ने ब्रह्म समंशुते ॥

Yadā sarve pramucyante kāmā ye'sya hṛdi śrītāḥ
Atha martyo'mṛto bhavatyatra brahma samaśnute. (Kaṭha Up: 2.3.14)

When all the desires that dwell in the mind are destroyed, then the mortal becomes the Immortal. Right here, he experiences that Brāhmic Consciousness.
There is again a subtle hint here that mind is influenced by desires and those desire form the basis of our karmic signatures. The main basis of Yoga and meditation is to let go these desires. Therefore, we get a direct hint that mind is programmed by our thoughts and action.

2.7.3. In Taittirīya:

यतो वाचो निवर्तन्ते | अप्राप्य मनसा सह | आनन्दं ब्रह्मणं विद्वान् न विभेदितिकदाचनेति ॥

Yato vāco nivartante aprāpya manasā saha| Ānandaḥ brahmaṇ o vidvān | na bibheti kadācaneti|| Tai. Upa. 2.4.1||

When speech recedes and the mind reaches not there, one realises Ānanda, the Brahman; there he fears not.

तद्वा अस्मैतदाप्तकाभभकाभभकाभं रूऩं शोकान्तयभ् ॥

Tadvā asyaitadāptakāmātmakāmākāmākāmarṇ rūparṇ Š okāntaratrah ||Bra. Upa. 4.3.21||

Embraced by his beloved wife, he cognizes neither the outer nor the inner worlds.

Bāhadāraēyaka, the biggest of the Upaniñads describes the best of the sense pleasures as the state devoid of thoughts outside or inside. They consider all human experiences.

In Bhagavat Gita
A person is said to have transcended all the three Gunas, when he is unaffected by any external imbalances or if he perceives anything he treats everything with equanimity.

The Purusha or consciousness is the enjoyer of everything and attaches to prakriti to give birth to all the Gunas.

When the mind gets relieved of all its desires (thoughts), man is bliss unto himself. He is then the Sthitaprajña.
All desires sprout in the mind. Hunger and thirst arise in the body no doubt. But these natural urges send up imperative messages or mandates to the relevant portion of the brain. That part of the brain sends up commands to the brain cortex which is the executive commander.

The desire is curbed in a quite a different way, sometimes. The mind is trained to think and believe that overcoming or curbing the desires, is a magnificent achievement. When desires are thus curbed, the mind feels intensely happy.

No animal ever tries to curb the desires and feel happy. But the human-animal has learnt this trick. The desire to acquire the power to curb, the natural desires, is also a desire, and is a ‘manogatān kāmān’. Such a desire is glorified, deified and considered noble and so people over the centuries have tried to cultivate, strengthen and eulogize it. Cultivating and developing this may justifiably called one of the main differences between animals and man because; such noble desires lift up man from his animal nature. Succeeding in this attempt, man becomes less of an animal and more of a man. Later on progressing on this path he can become less of a man and more of an idealist, tending towards divinity, divinity as we understand it, however vaguely.

A person that accomplishes this ideal can later on experience ānanda. After attaining that stage, he needed no longer exert himself, to maintain
the deified desire continues effortlessly. He can thereafter turn on ānanda anytime he so desire and gets into Samādhi.

Manogatān Kāmān includes the glorified desire also:-

Thus manogātān kāmān includes:-

(1) Desires, which relate to the satisfaction of the bodily urges, and these, as everyone is painfully aware, are a legion.

(2) Desires that crop up in the mental plane only, triggered off by sensory stimuli, which drag up the memory storehouse.

(3) Desires conjured up by the mind to curb the animal urges and lift him up to human and later to divine states.

The mind of an experiencer of ānanda or of the one in Samādhi will be in this state of complete freedom from all desires that may occur in the mind. When all the desires of the mind are (prajahāti) cast away, then the person has a firm mind, untrammeled by the happenings all around and within himself. He is said to be in Samādhi, then. It certainly is not a void or blank. A part the essence is intensely aware of the whole of cosmos or brahmānanda. The awareness is also blissful, and completely satisfying, so satisfying that nothing else remains to be desired. This feeling of ānanda identifies one with anything and everything so that there is nothing else at all. In such a state, one feels alone, there is no second or dvaita. (picked up terms). When all the desires are gone, whatever is left of
the mind is just ānanda and awareness. Such awareness is satisfied with itself, by itself and for itself. This must be so. Because the mind has nothing else to mind about.

2.8. **Summary of the scientific and ancient concepts of perception and thought and its effect on tendencies and genes.**

It is these tendencies that a man is born with again. Even the genome it selects is governed by the last thought and the *samskaras* or the karmic signatures of the life lived before the death. (Bhagavat gita) Even the Rigveda asserts that let noble thought come from all sides.

The impulse behind most human actions in so far as man is a psychophysical being comes from what are called *samskaras* (subliminal and latent tendencies) and *vasanas* (desires rooted in the psyche at an unconscious level but their force is also consciously felt). Each human being is born with a certain configuration of these *samskaras* and *vasanas* (their precise nature determined by action in a previous life) and these felt as attraction towards some things and aversion towards others, act as driving forces behind our actions, in so far as we act out the dharma of our being as part of nature.
On one hand one can look at identical twins separated at birth who lead very similar lives and share many behaviors -- this seems to support the dominant role of genes. But we can also point to studies of psychiatric patients with conditions like depression or OCD (obsessive-compulsive disorder Benedict et al 2006) who improve with talk therapy. That implies that a disorder associated with the brain's "hard wiring" is treatable through changes in "soft" things like behavior, emotions, and thinking.

This seems to leave us with circular reasoning: a machine controlled by genes is locked into pre-determined behavior unless an equally mechanistic influence from the outside changes that behavior. In other words, determinism is used as an explanation both for nature and nurture. If we abandon materialism and allow for the existence of a mind, with its rich panoply of wishes, desires, dreams, and impulses, the picture changes. Genes become the starting point, but free will and environment play an unpredictable role. When genes and uncertainty meet, the mixture is far more creative than neurology presently allows. A gene is inherited from the parents but bears the imprint of memory of function. (Gould et al 2006) But memory obviously doesn't rule us completely. As the Shiva Sutras say, "I use memory, I do not allow memory to use me." This gives us one of the tenets of enlightenment, that the human mind can free itself
from the past by going inward to the source of consciousness. In the Vedic view, the purpose of the past is to provide a vehicle for the present. We were born with a physical body, including the brain, outfitted with enough past memory (probably imprinted on the genes) to provide a direction for our life, a blueprint of our unique tendencies. As we interact with our surroundings, new material for memories comes in. The brain constantly incarnates its past experience by turning intangible events, emotions, sensations, and drives into cells; there is no need to wait for new genetic mutations when every neuron is capable of expressing itself across a wide range of experience. In other words, the body we have today is metabolized experience in all its accumulated richness.

However, we do know that accidents, drugs, surgery, shock treatments, strokes and tumours do a very efficient job of disorganizing various aspects of the brain.

The really interesting fact is that none of those qualities that comprise our mental character is immune from such accidents. We can lose our memory, our talents, the normal emotional tone of our personality, and our likes and dislikes because of various cerebral accidents and injuries. And
of course, we can lose all our faculties as well, such as the ability to reason, to form speech, to control our bodies, etc.

Now, if the subtle body is sufficient to support the existence of a mental life, including all our faculties and all the unique qualities of our mental character, then why is the brain also necessary, and why cannot these mental qualities continue when the brain is damaged?

One answer we can think of is that, once the subtle body enters a physical body, it somehow becomes limited by that physical body. It is as if we were sitting buckled in at the driver's seat of a car. If the engine breaks down, we can't go anywhere without unbuckling the seatbelt, opening the door, and leaving the car. The engine could correspond to any of our brain functions. So the greatest challenge is to master the meeting point between past, present, and future. In the Indian spiritual tradition, the highest achievement was complete freedom from all three *Guṇas*. The Self or Atman, being pure consciousness, has no predetermined qualities. It exists in the realm of pure potential. Modern society doesn't have a value system that equates freedom with enlightenment, but with new advances in brain research, we are at least seeing the fingerprints left by the mind on the brain, and we can observe how experience gets metabolized into various receptors and neural networks that are unique for each individual. Science
cannot yet explain why two people with a similar genetic makeup and experiences can turn out so differently, or so closely, for that matter. but the potential for recognizing consciousness as the source for both nature and nurture may be the most exciting possibility looming ahead.

In fact our intentional and unintentional visualization inspires DNA 24 hours a day, 365 days a year. We are simply unaware of the process. So we continually affect our genetic code and the nature of the effect is largely down to the nature of our thoughts, feelings, attitudes, beliefs and intentions. Therefore, controlling the mind should lead to the possibilities of controlling or influencing the action of genes to either partially or wholly. This is the basis that Yogic control of the mind is possible to affect the function of the genes and thus facilitate the treatment of cancer.

2.9 Relevance of this literature on perception and mind control in context to cancer.

2.9.1. The modifications of mind and molecular concepts of Cancer:

Molecular concept of cancer: - According to R.A. Weinberg 1998 Cancer is not one disease but a disorder. No matter what cancer takes, it remains
a malady of genes, and most, if not all, causes of cancer act by damaging
genes directly or indirectly. The genetic paradigm has greatly enhanced
our understanding of cancer and now guides most researches on the
disease. Cancer is essentially a rapid and unregulated division of cells. It
has been seen that the rate of cell division varies with different cell types.
It is possible for perfectly normal cells, e.g., blood forming cells, to have a
high rate of division than some cancerous cells.

Tim Hunt 1997 reviewed that Cancer results from a breakdown of the
regulatory mechanism that governs the division, differentiation and
survival of the individual cell. As a result of the loss of regulation, the
cancer cells grow and divide in an uncontrolled manner. They ultimately
spread throughout the body, interfering with the functions of normal tissue
and organs. Each cancer cell has a characteristic life span. Some cells end
their life span by death and degradation. Others complete their life span by
division. Normally, the overall rate of cell division is high in growing
animals, so that cell multiplication is greater than cell death. Once the
steady state is reached in others, the origin of new cells and the death of
old cells are balanced. Some cells are highly specialized, while others
remain relatively undifferentiated.
First, cancer is fundamentally a disease of individual cell (Kornberg 1979). The complexity of the cancer can be understood only through attention of genes, cancer is a perversion of cellular phenotype, and genes are the determinants of that phenotype. DNA and its behaviour is quite sophisticated, and we currently lack an understanding of its exact behaviour or characteristics. DNA is responsible for the creation of perhaps the most sophisticated of creature; the human being. However, nature has also engendered cancer formations, as well as other phenomenon that are capable of destroying us

Hanahan D and Robert Weinberg in their classical review in Cell, 2000 described cancer as a multifactorial genetic catastrophe. Robert A. Weinberg, PhD, is an internationally recognized authority on the genetic basis of human cancer, having isolated the first human cancer-causing gene and the first known tumour suppressor gene.
Figure 2.6.

Cellular Mechanisms of Tumor Growth and Progression

Cancer results from an accumulation of mutation-induced aberrations in cellular proliferation, survival, migration and invasion

Oncogenes – activating mutation or overexpression promotes tumor growth and progression

Tumor suppressor genes – inactivating mutation or loss promotes tumor growth and progression
2.9.2. Events in Cancer on set (Geoffrey L. Greene, et al 2000)

1. Mutation. (Change in the structure or function of a coding gene)

2. Cell cycle check points are lost. (regulatory mechanism of division)

3. Tumour formation [Benign/Malignant] (accumulation of cells)


5. Increase in tumour size. (more violence in the molecular level)

6. Angiogenesis: formation of arteries and veins [Neovascularization*]

7. Metastasis of tumour [delocalization of tumours]

8. Tumour invasion to vital organs. (Gain of function over the normal physiology)

9. Multi-organ malfunctioning. (Homeostasis breaks down completely)

10. Death of the individual who is affected with cancer. (System fails)
Figure 2.7.

Cancer – General

- Classifications
  - carcinomas – epithelial cells (most common)
  - sarcomas – connective tissue cells
  - neural tumors
  - non-solid tumors
    - leukemia – blood forming cells
    - lymphoma – immune cells

- Tumor Types
  - benign – remains local
  - malignant – invasive

- Incidence in America
  - more than 1,000,000 new cases diagnosed each year
  - more than 500,000 deaths each year

Figure 2.8.

The Cellular Hallmarks of Cancer

Hanahan and Weinberg (2000)
Cell 100, 57-70.
2.9.3. Pathways of Oncogenesis

The control of the cell proliferation and cell fate is central to the proper differentiation of specific cell types, maintenance of tissue, homeostasis, and the ability of certain cell types to respond to mitogenic signals. (cyclins) (Paul Nurse 1983) Loss of this control underlies many human diseases, including cancer. The gene regulatory pathway governed by the retinoblastoma tumor suppressor protein (Rb) that is responsible for control of expression of genes encoding proteins that effect the replication of DNA and facilitate the orderly passage through cell growth. Recent studies have illustrated the fact that various cell fate decisions that trigger apoptotic pathways are tightly linked to the function of the Rb pathway.

The normal cell cycle consists of four segments; G1, M, G2, and S. The cell commits to replicating chromosomal DNA and the check-points at the G2 to M transition associated with entry into mitosis.

There are several genes and enzymes which help in controlling cell cycle. The important and master of all is p53 which acts prior to DNA synthesis, by checking DNA damage and delaying entry into S until the damage is
repaired. This gene along with Rb and often several enzymes maintain homeostasis.

The p53 is a protein (phosphor- protein) coded by p53 gene which functions as a transcriptional activator, this property is responsible for its tumour suppressing activity. This p53 induces the transcription of a gene encoding a 21 KD protein that interacts with and controls various cyclin-Cdk complexes. These cyclin-Cdk complexes are responsible for activation and inactivation of Rb gene which gives Rb protein. This activation and inactivation is done by phosphorylation and de-phosphorylation of Rb protein. When the Rb is active (non-phosphorylated form), it goes and bind to the transcriptional factor E2F which is needed for promoting transcription and halts the process of transcription thus, stopping the cell cycle. If the Rb is inactivated (phosphorylated form), then it cannot bind to E2F thus promoting transcription process and helping to move the cell cycle.

The cell cycle works with a great coordination of different enzymes and proteins along with p53. The mutation or change or non-functioning of any of the component of cell cycle leads to tumour or cancer. There are various pathways which leads to cancer, it may be
2. Mutation in Rb.
3. In production of cyclins and kinases.
4. Inactivation of cyclins and kinases.

Improper functioning of many other components of cell cycle also leads to alterations.

2.10 Genetics of Cancer
Cancer originates from changes in DNA that result in unregulated cell division. Most of these changes are mutations that involve changes in the DNA sequence. The mutations may arise as a result of errors in replication or DNA repair, or exposure to carcinogens. Nearly all cancers are genetic in origin, but fortunately most cancers are not inherited. (James P. Allison, 1999)

General classes of cancer genes (Bert Vogelstein et al 1997, 2000, 2001)
There are three general classes of genes, oncogenes, tumor suppressor genes and DNA repair genes.
(i) Oncogenes:
Cells posses a variety of genes called proto-oncogenes, which encode proteins that carry out the normal activities of the cell and promote normal
cell growth. Activation of proto-oncogenes by point mutation, converts the proto-oncogenes into oncogenes (tumor-causing genes). Oncogenes encode proteins that promote loss of growth control and transform the cell to a malignant or neoplastic state. Thus oncogenes are genes whose action promotes cell proliferation.

Cellular oncogenes causing human cancer were discovered by Krontiris and Cooper (1981) and Shih et al. (1981), and were thought to be dominantly acting. However, some 20 years before this discovery, cell hybridization experiments had been carried out to make a genetic analysis of malignant. Barski and Cornefert (1962) and Scalettan and Ephrussi (1965) fused some mouse cells of high and malignancy potential and found that the resultant hybrid cells were malignant. This led to the interpretation that malignancy was a dominant trait, supporting the concept of ‘dominantly acting’ oncogenes.

Later, experiments of Harris, Klien and colleagues (1969, 1971) however, yielded results contrary to the concept of dominantly acting oncogenes. Malignancy was shown to be a recessive in these cell fusion experiments.

(i) Malignant cells contain both regulatory genes (TSGs) and oncogenes
Cellular proto-onco-genes are involved in many of the processes regulating cellular growth. The activation of cellular genes that are not expressed in quiescent cells is likely to be involved in the continuation of cellular growth. Several proto-onco-genes encode transcription factors which regulate the transcription of genes in growing cells.

Viral and cellular onco-genes are genes that contribute to the abnormal behaviour of malignant cells. Many proto-onco-genes encode proteins that are involved in the regulation of normal cell proliferation. Their corresponding onco-genes encode onco-genic proteins that result in uncontrolled proliferation of cancer cells. The mechanisms involved in this process include elevated expression (up regulation) of the onco-genes, defective differentiation and failure to undergo apoptosis (programmed cell death). Most onco-protein functions as components of signalling pathways that regulate cell proliferation in response to stimulation by growth factors. These onco-proteins include polypeptide growth factors, receptors for growth factors, components of intracellular signaling pathways and transcription factors.
Figure 2.9.

**TUMOR SUSCEPTIBILITY GENES**

<table>
<thead>
<tr>
<th>Gene</th>
<th>Chromosome</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>RB</td>
<td>13q</td>
<td>Nuclear, transcriptional regulation</td>
</tr>
<tr>
<td>p53</td>
<td>17q</td>
<td>Nuclear, transcriptional regulation</td>
</tr>
<tr>
<td>p73</td>
<td>1p</td>
<td>Nuclear, transcriptional regulation</td>
</tr>
<tr>
<td>WT-1</td>
<td>11p</td>
<td>Nuclear, transcriptional regulation</td>
</tr>
<tr>
<td>NF-1</td>
<td>17q</td>
<td>Cytoplasmic, regulating ras family members</td>
</tr>
<tr>
<td>APC</td>
<td>5q21</td>
<td>Cytoplasmic, Chromosome segregation</td>
</tr>
<tr>
<td>DCC</td>
<td>18q21</td>
<td>Cytoplasmic, cell adhesion</td>
</tr>
<tr>
<td>MLH</td>
<td>3p21</td>
<td>Nuclear, DNA repair enzyme</td>
</tr>
<tr>
<td>p16</td>
<td>9p21</td>
<td>Nuclear, inhibitor of CDK</td>
</tr>
<tr>
<td>BRCA1</td>
<td>17q21</td>
<td>Nuclear DNA repair recombi</td>
</tr>
<tr>
<td>PTEN</td>
<td>10q23</td>
<td>Cytoplasmic, lipid phosphatase</td>
</tr>
<tr>
<td>TGFbRII</td>
<td>3p22</td>
<td>Cytoplasmic, receptor kinase</td>
</tr>
</tbody>
</table>

Tumor suppressor genes or ‘anti-oncogenes’: (Kenneth Kinzler, 1997 et al)

Normal cells contain genes on their chromosomes that suppress unregulated cell growth. These genes are called tumor-suppressor genes (TSGs) or ‘anti-oncogenes’. TSGs encode proteins that restrain cell growth and prevent cells from becoming mutant. Suppression of uncontrolled proliferation, a characteristic of cancer cells, is in effect tumor suppression. The normal products of TSGs have an inhibitory role in cell growth and division. In certain cancers, specific chromosome
regions are deleted from both homologues, resulting in deletion of both alleles of the TSG. Inactivation of the TSG alleles results in the loss of the inhibiting activity. This in turn results in unregulated cell proliferation.

Since mammalian cells are diploid, most genes are represented by pairs of alleles. Somatic mutation of one allele of a TSG results in heterozygosity at that locus. (Knudson 1978) This usually does not have significant consequences, and there is normal growth control. The normal allele codes for sufficient gene products for normal function. In some individuals the cells have inherited loss of function of one allele of the TSG, with the other allele remaining functionally normal. Such individuals do not develop tumours caused by the particular gene. Only when a mutation takes place in the remaining normal allele will there be uncontrolled cell growth. Thus mutation or loss of both alleles of a TSG is necessary for a cell to lose growth control. Such a cell will lack any copy of the wild type (normal) allele, and the protein encoded will therefore be inactive. Thus tumour-suppressor mutations that are found in tumour cells are recessive.
2.11. Effect of Stress and Cancer - Need for mind modifications:

The cellular stress response is evolutionarily conserved in all living organisms, and a major role is attributed to the induced heat shock proteins (Hsps) and other molecules that confer stress protection. The molecular responses elicited by the cells dictate whether the organism adapts, survives, or, if injured beyond repair, undergoes death. Most of the time these responses are beneficial to the organisms, but sometimes cells like cancer cells mount defensive mechanisms that interfere with therapies. Our detailed understanding of stress responses has paved the way for the development of stress-tolerant crops in several instances (Grover et al 1999).

According Griffith et al 1996, apoptosis is mediated by extrinsic (receptor-mediated) and intrinsic (mitochondria-mediated) signalling pathways that converge in the activation of caspases (which activates the death signal pathway).
Apoptosis or programmed cell death is a self-destruct mechanism by which multi-cellular organisms eliminate damaged cells. If DNA repair fails, the p53 protein can trigger damaged cells to undergo apoptosis. Thus the cell is destroyed before its genetic abnormalities can be inherited. In the absence of a functional p53 gene, the p53 protein is not produced. Therefore the p53 apoptosis pathway cannot be activated. The cell cycle thus progresses without DNA damage being repaired. This results in an increase in the overall frequency of gene mutations, chromosomal rearrangements and aneuploidy. Thus the chances of other mutations promoting cell proliferation or blocking apoptosis are increased. The cells become genetically unstable and go on accumulating more and more genetic damage. This may lead to the formation of malignant tumors. The p53 tumor suppressor gene therefore serves as a link between the cell cycle and apoptosis.

Cysteine protease activation is an early hallmark of apoptosis. The activation of the inactive pro-caspases occurs in a hierarchic cascade in which the apoptotic signal activates an initiator caspases, which in turn activates the effectors caspases. These proteases initiate the degradation
phase of programmed cell death, giving rise to the morphological features of apoptosis (cytoplasm and nuclear condensation, cytoplasm shrinkage, cell membrane blebbing, chromatin clumping at the periphery of the nucleus, endonuclease-mediated deoxyribonucleic acid [DNA] cleavage, and formation of apoptotic bodies). Recent evidence suggests that Hsps may block the cell death pathways at different levels. Because cellular homeostasis is a balance between survival and death, Hsps and other chaperones play a pivotal role to support this sensitive balance. With respect to cancer treatment, chemotherapy is one of the most common therapies. Unfortunately, anti-neo-plastic drug resistance, attributable in part to blocked apoptosis, is an important cause of failure in cancer treatment.

Dr Stuart K. Calderwood explains that under highly concentrated conditions, proteins are at risk of aggregation, which is a cellular catastrophe. Such effects, however, rapidly trigger the activation of the heat shock transcription factor (Hsf) and the expression of Hsp molecular chaperones. This group studied the regulation of Hsf1, Hsf2, and Hsf4 in normal cells and in prostate carcinoma during malignant transformation and under conditions of exposure to cancer therapy. Expression-profiling studies indicated that each of the factors is expressed at equivalent levels
during malignant progression, in line with the high degree of conservation of the response. However, Hsf1 activity and Hsp expression played significant roles in the generation of the malignant phenotype and in the resistance to clinical cancer treatment.

From the above review of literature we find that stress plays a vital role in development of cancer. Dr Stuart K. Calder Wood explains that under highly concentrated conditions, proteins are at risk of aggregation, which is a cellular catastrophe. Such effects, however, rapidly trigger the activation of the heat shock transcription factor (Hsf) and the expression of Hsp molecular chaperones. This group studied the regulation of Hsf1, Hsf2, and Hsf4 in normal cells and in prostate carcinoma during malignant transformation and under conditions of exposure to cancer therapy. Expression-profiling studies indicated that each of the factors is expressed at equivalent levels during malignant progression, in line with the high degree of conservation of the response. However, Hsf1 activity and Hsp expression played significant roles in the generation of the malignant phenotype and in the resistance to clinical cancer treatment. It is due to chronic stress and production of Hsps that tumour display immortality and resistance to various therapeutic treatment modalities. Therefore, stress reduction and a holistic approach to cancer treatment is the current need to
develop an integrated approach to cancer management. As referred earlier that all elements in पक्षी are governed by गुणas, therefore we can draw a rational that even Genes (both functional and non functional) follow the dharma and karma of the three गुणas. The normal functioning of “House keeping genes” follow the balance of satva, tamas and rajas. The genes which are dormant and do not function on a regular basis can be called as तमसिक. The genes which expresses on a dynamic and regular scale can be called as राजसिक genes. The genes which govern the subtleties of function can be called as सत्विक genes. The proto-oncogenes which are dormant in most of the normal individuals are influenced by chronic exposure to stress and get transformed into Oncogenes and acquire violent emotions. The signal from the stress forms a vicious cycle and continuously give growth signals which leads to immortality.
Robert W. Woodruff reviews that there is growing attention to the health benefits of mind/body interventions, particularly relaxation and meditation. Biomedical research has provided undeniable evidence of the interconnectedness of the mind and body. The field of psychoneuroimmunology has defined the role of stress in reducing effectiveness of the immune system in combating infection and growth of malignant tumours. There are considerable evidences Kiecolt –Glasser et
al 2001 et al (reviewed in the next chapter) that Yoga and meditation practices have been successful in managing various stress related effects due to cancer. In addition, there are encouraging reports of studies citing the influence of melatonin on breast and prostate tumours. A preliminary study finds an association between meditation practice and levels of melatonin produced by the pineal gland.

We know that each parent contributes 50% of the genome of a child and the permutation and combination of each parental genotype gives rise to the genome of the offspring. But the tendencies and characteristic may resemble to some extent to the parents but the core tendencies and vasanas or intense desires are the grossified form of the prarabdha and sanchita karma. The environment plays an important role in specific gene expression at the both macro and micro level. But these tendencies can be modified or influenced by sadhana and deep meditation. Going into deeper realms of our consciousness we can touch the subtle layers of silence and pure consciousness which may result in modification of the gene functionality. All this above ancient literature and scientific research converges to an idea of using an integrated approach of Yoga and mind modification techniques to bring about a regulatory effect in controlling the catastrophic effects of cancer. There is too much speed in the current
world order which can be compared to the entropy factor in Physics. This excessive speed has lead to the imbalances in the panic channel which has lead to diseases like cancer. These imbalances cannot be treated with only external therapeutic intervention alone. There is a serious need to address the imbalances at all levels of our existence. Therefore, an integrated approach of yoga therapy must be developed each disease and its cure. Stress in any form both psychological and physiological has been known to be associated with cancer from the time of diagnosis. Yoga is an ancient eastern system which is being extensively used in research worldwide to study the effects in reducing the stress at the psychological and physiological levels.