Chapter 4

Review of Scientific Research on Altered States of Consciousness

Scientific Research -

Due to our limited consciousness, bound by sense experiences which become dull and monotonous due to endless repetitions, modern man today is unable to break out tensions, anxieties, problems and so he is facing both material and spiritual crisis.

We are witnessing worldwide tremendous interest in yoga, meditation and spiritual values. There has been revival of the yogic lifestyle and knowledge. Yoga and related sciences are now recognized as valuable tools within the healing profession and have added tremendous depth and height, a new dimension to psychology and philosophy. Scientists have been inspired to probe deeper into the mysteries of yoga, to investigate the means by which it works and spread the teachings of the ancient rishis and yogis more readily understood and expressed in the modern scientific terminology. We are seeing that science is not actually discovering anything new, but is substantiating the ancient knowledge of seers.

Scientific investigation into yoga and the allied sciences has made this knowledge more accessible by incorporating it into a whole set of new therapeutic techniques and new methods to develop our potential, e. g. biofeedback, autogenic training, mind control techniques, psychic healing etc. New branches of medicine have come into being and the recognition of mind, begun by Freud in twentieth century and in Yogavāsiṣṭha etc., have finally gained acceptance. So stress medicine and psychosomatic
medicines are developed by understanding mind, body, medicine and beyond in this era 3.

Time and again, various teachings of many of the yogis, saints and sages from all ages have been verified by modern science. ‘Altered states of consciousness’ has become a subject of scientific research all over the world. But there are limitations to this research. Let us study the limitations.

**Limitations on Scientific Research of altered state of consciousness**

Some of the characteristics of altered states of consciousness are ineffability, timelessness, transience etc. as per various scriptures studied so far.

Hence it seems impossible to define or describe these states by scientific means which are based on the principle of experiment, observation and inference. These states are beyond the realm of time and space. So it is like trying to understand atomic particle with no reference to nuclear science.

In a nutshell the constraints are:-

1. All research done is in parts on a particular practice without reference to the vast inner world of human psyche.

2. Different researchers lay emphasis on particular schools such as Zen, Vipassanā and The Tibetan system.

3. Very little information is obtained about the comparison of results after different meditation techniques.

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4. The methods of some systems such as TM, relaxation response, mindfulness etc are very well defined. But the methods used by some yogis or Tibetan lamas are Tantric methods are tested based on vague description. It is not vague to the research subjects, but it is vague for investigators and readers. The step by step, research methodology is also not stated.

5. If the researcher is a meditator, then it is unscientific as he may have personal interest in the practice. e.g. There was objection on Dr. Davidson, who was researcher on Advanced Tibetan lama-s at the University of Wisconsin, as he meditates himself.

6. The Meditation researchers also may get confused with phenomenon observed in brain pathologies as -
   a) Delta: -- achieved in yoganidrā² also signifies a state of coma or impending death.
   b) Theta:--common in children is sometimes seen as indicative of brain damage in adults
   c) Alpha:-- may be induced under influence of drugs
   d) High Beta:-- may indicate a very scattered mind without focus.

In this chapter we are going to discuss scientific research done in the world on altered state of consciousness during last eight to nine decades. We will also study the effects on five sheaths of existence i.e. the physical, mental, intellectual and spiritual level.

² Research on yoganidrā and its effect on brain waves is given in this chapter.
Here we are compiling information on research done on various systems of yoga in the order as given in Chapter 3,

1) **Haṭhayoga:**-- It is generally accepted by scientists that psychic energy, widely known as *bioenergy*, is body based and affects both the physical and mental spheres as indicated by yogis. It has also been measured as a force field surrounding the body up to a distance of twelve feet by Yale neuropsychiatrist, Dr Leonard Ravitz. This seems to support yogic concept of subtle prāṇic body which interpenetrates and is independent with the physical structure, motivating it to function.

2b) Dr. Grendy Sergeyev of the A. A. Utkomskii Physiological Institute (a Leningrad military laboratory) took readings of the brain waves, heart beat and pulse rate of Neyla Mikhalova during her numerous demonstrations of Psychokinesis. He found that while Mikhilova was causing objects to move without touching them, his instruments recorded tremendous vibration throughout her body and its surrounding force field which pulsed in the direction of her gaze. Her heart and brain waves also pulsed in unison with this energy vibration, indicating that the energy Mikhililova used in her psychic feat is intimately connected with her whole body.

2) **Rājayoga:**-- Techniques such as *yoganidrā* is a systematic tantric nyassa method to relax the body. The relaxation of cerebral cortex in *yoganidrā* is measured in following experiment.

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EEG⁵:- By placing electrodes on the scalp and leading via suitable amplifiers to a cathode ray oscillograph, or to ink-writing device, a record is obtained of the electrical activity of the cerebrum. The brain is in a constant state of electrical activity which can read as brain waves by a machine called an EEG. (Electroencephalograph).

In a normal subject who refrains from mental activity and keeps his eyes closed, the usual pattern of electrical activity consist of a sequence of waves which recur at a frequency of 8-12 Hz. These alpha waves occur in bursts or spindles, gradually building up and then receding. On opening the eyes, the regular alpha rhythms are replaced by small irregular oscillations. A typical distribution of electrodes is shown in Figure A.

![Figure A](image)

The maximum numbers of alpha rhythms are present in the occipital and parietal-occipital areas and are usually diminished by visual or mental activity. Theta rhythms are often found over the parietal and temporal areas, the waves having low amplitude of 10 micro volts. Delta waves dominate in deep sleep.

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<table>
<thead>
<tr>
<th>Frequency (Hz)</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3.5</td>
<td>Delta</td>
</tr>
<tr>
<td>4-7</td>
<td>Theta</td>
</tr>
<tr>
<td>8-13</td>
<td>Alpha</td>
</tr>
<tr>
<td>14-30</td>
<td>Beta</td>
</tr>
</tbody>
</table>

During the normal sequential pattern of descent from wakefulness to deep sleep, the brainwave frequency changes from fast beta waves (about 14 cycles per second), to theta waves (4-7 cycles per second) and, lastly, to delta waves (0-4 cycles per second).

The difference between normal sleep and yoganidrā is that in yoganidrā an intermediate platform of alpha wave predominance (7-14 cycles per second) associated with relaxation, is created between the beta wave patterns of the wakeful state and the slow delta rhythm of deep sleep. The result of this, is complete relaxation of mental, emotional and muscular tension.

3) **Mantrayoga** - The scientific effects of mantra in changing level of consciousness is used in the ultrasound therapies. We will review few experiments on sound and music Like the binaural beats experiment, Ultrasound patches are also developed for skin treatment and deactivation of skin enzymes.\(^6\) The effects of this therapy is similar to chanting of certain mantra-s to have positive effect on the state of consciousness.

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1a) **Binaural Beats**

These are a variation of brainwave entrainment, creating an oscillation effect between the frequencies flowing into each ear and the frequency resonated in the brain. The oscillation effect is what happens when ringing a tuning fork and placing it next to another tuning fork at rest; if the tuning forks play the same note, or vibrate on the same frequency, the tuning fork at rest will begin to ring. Two different frequencies stream into the ears of an individual, preferably wearing headphones, creating a binaural beat within the brain. By introducing one frequency in one ear, and another in the opposite ear, the hemispheres of the brain are obliged to interact and communicate with one another to hear the binaural beat, causing hemisphere synchronicity. Evidence has implicated both the superior olivary nucleus in the brainstem and the inferior colliculus as the area(s) where the binaural beat is created and heard within the brain.

**Effects of Binaural Beats**

The physiology and psychophysiology of human beings is affected beyond the scope of hemisphere synchronicity though! Several studies have reported reductions in anxiety, dopamine, insulin-like growth factor-, stress, and sleep requirements, as well as increases in learning ability, creativity, higher states of consciousness, lucid dreaming, astral projection, and more. This proves binaural beats to have an effect that goes beyond

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potential placebos or perceptions; they have a fundamental biochemical effect on the body as well!

Binaural beats have also been successfully incorporated in treatment plans for pain management, addictions, depression, migraines, and low self-esteem.

Some people also experience hypnagogic states, which are states of consciousness between waking and sleeping, often referred to as threshold consciousness. During these states, people may experience visual or auditory phenomenon such as seeing colors, shapes, and patterns, or hearing snippets of conversations, various sounds, and voices.

Various frequencies are associated with different effects as well. Beta frequencies increase awareness and alertness, improving focus and memory; alpha frequencies are great for meditative states and accelerated learning. Theta frequencies are also used for increasing an individual’s learning ability, creativity, enhancing meditative states, and results in sounder sleep from the induced relaxation. Scientists have found children spend much more time in the theta frequency than adults, which is one reason why they are adept learners in comparison. Finally, delta frequencies have similar effects as theta waves, except for delta waves are closer associated with deeper sleep stages.

<table>
<thead>
<tr>
<th>State</th>
<th>Frequency range</th>
<th>State of mind</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delta</td>
<td>0.5Hz – 4Hz</td>
<td>Deep sleep</td>
</tr>
<tr>
<td>Theta</td>
<td>4Hz – 8Hz</td>
<td>Drowsiness (also first stage of sleep)</td>
</tr>
<tr>
<td>Alpha</td>
<td>8Hz – 14Hz</td>
<td>Relaxed but alert</td>
</tr>
<tr>
<td>Beta</td>
<td>14Hz – 30Hz</td>
<td>Highly alert and focused</td>
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There is a caution when using beta waves for an extended amount of time, as beta frequencies can create a mental fatigue from generating an imbalance between the potassium and sodium ratio. Luckily, if this does occur, even brief periods of the theta state can correct the imbalance.

This technique of brainwave entrainment is most effective when combined with music, positive affirmations, or biofeedback. Adding these modalities to binaural beats creates a multilayered approach to inducing altered states of consciousness, relaxation, and expanding your scope of understanding.

However, openness may not be the only success prohibiting factor with binaural beats; several studies have reported age may play a role in how the brain is able to process the binaural beat.

**Conclusion** - Some people have been using binaural beats for several months and they have noticed amazing advantages. Their quality of sleep is enhanced; dreams are more vivid, easier to remember, and they have more instances of lucid dreaming; their cognitive processing is quicker and more advanced (i.e.: thinking more clearly, efficiently, and quickly); and they are able to relax easier on a whim. The most important benefit binaural beats have to offer is the ability to train your brain to enter altered and higher states of consciousness, when you’d like to experience them. Binaural beats can ease you into meditative states without creating a dependence on the audios. Ultimately, they serve as a brainwave inducer and exercise your brain to enter these states upon command.
4) **Kuṇḍalinī Yoga** - Scientific research conducted by Dr. Motoyama⁸ -
He developed AMI-Apparatus for measuring the functional conditions of
Meridians and their corresponding Internal organs. This is an instrument
designed to measure the initial skin current, as well as steady state current,
in response to DC voltage externally applied at special acupuncture points
located along finger and nails. With this Dr. Motoyama did experiments on
thousands of patients to prove acupuncture and the yogic concept of nādi-s
have the same foundation and have affected each other for last 2000 years.

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⁸ Hiroshi Motoyama, *The Theories of Chakras*, New Age Books, New Delhi, Indian edition 2001,
p. 258.
The Chakra Instrument
- Head Amplifier -

The Chakra Instrument
- Electrode Box -

The Chakra Instrument
- DC Amplifier, Signal Processor -
Dr Motoyama has done pioneering research in yoga and *kunḍalinī* and *cakra*-s. The *Cakra* Instrument was designed to detect the energy generated in the body and thus emitted in terms of various physical variables. It detects minute energy changes (electric, magnetic and optional) in the immediate environment of the subject.

It is probably due to correspondence between chakras and nervous plexuses that yogis may undergo physiological changes. Various studies were carried out on group of 100 people as -

Group A - people in whom *cakra*-s evidenced advanced activity

Group B - people in whom *cakra*-s evidenced beginning activity

Group C - people whose *cakra*-s were dormant.

In studies, it was concluded that -

1) Those who have active *cakra*-s tend to have wider ranges of related autonomic activity, as revealed through functional excitement and /or instability, than those whose *cakra*-s are not yet active.

2) The type of psi ability evidenced does seem to be connected to the specific *cakra*-s.

3) Awakening of *mūlādhāra*, *svādhiṣṭhāna* and *maṇipura cakra* have little potency to independently create something in outside world. But after *anāhata cakra*, one gets the ability to actualize desires in outside world. Dr. Motoyama says he received abilities such as telepathy, clairvoyance etc.
Further most important of his finding is psychic energy working in anāhata cakra may be able to create energy in physical dimension as light, electricity etc. But this needs to be further investigated.

4) Effect at Pañcakosha level -
Though lot of data is available from so many institutes all over the world, regarding existence and effects of Altered states of consciousness only, few are selected for discussion in the following pages, showing how meditative states influence various levels of our personality viz physical, vital, mental, intellectual and spiritual level (pañcakośa).

In the meditation techniques most frequently used are Zen, Vipassanā (mindfulness), ajapājapa (under the brand name of TM), relaxation response (basic progressive relaxation) and some Tibetan Buddhist meditation practice.

**Curing of disease -**

A.1) Physical level (annamaya kośa level) - At physical level, we will study the effects of higher state of consciousness on major systems in the body -

a) Effects on circulatory system -
a.1) American College of Cardiology • During its annual convention last year, the ACC hosted a symposium on the research conducted at more than a dozen independent universities and medical schools on the effects of the Transcendental Meditation technique for reducing heart disease, hypertension, stroke, cholesterol, atherosclerosis, and heart failure. Enclosed details of paper on blood pressure which was Published in final edited form as: Curr Hypertens Rep. 2007 December; 9(6): 520–528.

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This was a Systematic Review and Meta-analysis by Maxwell V. Rainforth, PhD, Robert H. Schneider, MD, Sanford I. Nidich, EdD, Carolyn Gaylord King, PhD, John W. Salerno, PhD, and James W. Anderson, MD

Thus, they observed that there is sufficient evidence that, among stress reduction programs, the Transcendental Meditation program is effective and warrants recommendation to patients with elevated blood pressure in preventing or treating hypertension and CVD.

**a-2) Autonomic changes while mentally repeating two syllables—one meaningful and the other neutral**

The study was on 12 sādhaka-s in three types of sessions

1. Before, during and after repeating öm”
2. same by repeating öne
3. with non-targeted thinking

It was observed that highly experienced meditators show a significant reduction in heart rate and a non-significant trend of reduction in oxygen consumption while repeating öm”, and these subjects displayed increase in cutaneous vasodilation, which is interpreted as increase in mental alertness.

**a-3) Immune system:**

A group of researchers at Infanta Cristina Hospital in Spain have published an interesting study which measures the effect of regular TM practice on one’s immune system. Here group of 16 healthy people was compared with 19 people who regularly practice TM Meditation.

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The scientists stated in their conclusion, “The technique of meditation studied seems to have a significant effect on immune cells. This effect is manifest in the different circulating levels of lymphocyte subsets analyzed.”

A - 4) Study: Cancer patients benefit from meditation

Four out of every five breast cancer patients undergo complementary therapies to manage anxiety and stress after they receive a diagnosis. A new study conducted by Columbia University in co-operation with several major oncology facilities examined which therapies benefit patients the most. The answer is Meditation and yoga.

**Practice guidelines for medical institutions**

The impressively thorough study looked at 80 different alternative therapies and covered more than 4,900 clinical trials from the past 25 years. Therapies were graded with respect to their effectiveness in treating various symptoms. Overall, meditation (including the Transcendental Meditation technique), yoga, and relaxation with imagery were found to have the strongest evidence supporting their use.

**Conclusion:** Patients now know which therapies to go for women with breast cancer among the highest users alternative, non-inventive therapies.

**A.2) Prāṇamaya kośa level -**

2.1) **Stanford University:** A meta-analysis of 146 independent studies found that the Transcendental Meditation technique is twice as effective at

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12 published in *Journal of the National Cancer Institute Monographs*, Oxford University Press,

Reducing trait anxiety when compared with concentration, contemplation or other techniques.

**Stanford University Research Study**

**Effective for Stress and Anxiety**

- Transcendental Meditation technique

**Decreased Cortisol**
The Stress Hormone

- Controls
- Transcendental Meditation technique

$p < .001$

**A-3) Research at Manomaya Kośa level -**

1) There are over 1200 studies showing the people who have a committed religious faith are more likely to enjoy better health. A committed religious faith also called as Intrinsic Faith is defined in terms of regular attendance to one’s place of worship, regular reading of scriptures and faith. Extrinsic faith applies to people who profess some religious application, but does not practice in committed daily manner. People with extrinsic faith along with atheist and agnostics have been shown by research to have Power health. Studies have shown benefits in praying for sick 393 patients suffering from heart disease were randomly assigned to two groups. One group was prayed for by a group outside hospital, while the control group was not prayed for. None of the patients know whether they had people praying for them. It was shown that recovery of those who were prayed for, was much better, Another study of 990 patients showed similar results. The increased longevity is attributed to Intrinsic Faith by some.

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A-4) Research at *Vijñānamaya kośa* level:-1) Increased brain reserve after TM.\(^\text{15}\)

During the Transcendental Meditation program, early (sensory) components of the brain’s response to somatosensory stimuli are more widely distributed across the cortex, indicating greater participation of the whole brain in the response to a stimulus.

A-3-2) Increased creativity\(^\text{16}\)

This study used the Torrance Test of Creative Thinking to measure figural and verbal creativity in a control group and in a group that subsequently learned the Transcendental Meditation technique. On the post-test 5 months later, the Transcendental


Meditation group scored significantly higher on figural originality and flexibility and on verbal fluency.

**A-3-3) Meditate on This: Buddhist Tradition Thickens Parts of the Brain**

Meditation alters brain patterns in ways that are likely permanent, scientists have known. But a new study shows key parts of the brain actually get thicker through the practice. Brain imaging of regular working folks who meditate regularly revealed increased thickness in cortical regions related to sensory, auditory and visual perception, as well as internal perception -- the automatic monitoring of heart rate or breathing, for example.

The study also indicates that regular meditation may slow age-related thinning of the frontal cortex.

"What is most fascinating to me is the suggestion that meditation practice can change anyone's gray matter," said study team member Jeremy Gray, an assistant professor of psychology at Yale. "The study participants were people with jobs and families. They just meditated on average 40 minutes each day, you don't have to be a monk."

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17 Sara Lazar, Assistant Professor at Maschesetts General Hospital, Published in Neuro Report, November.
The study involved a small number of people, just 20. All had extensive training in Buddhist Insight meditation. But the researchers say the results are significant.

Most of the brain regions identified to be changed through meditation were found in the right hemisphere, which is essential for sustaining attention. And attention is the focus of the meditation.

Other forms of yoga and meditation likely have a similar impact on brain structure, the researchers speculate, but each tradition probably has a slightly different pattern of cortical thickening based on the specific mental exercises involved.

In nutshell, in planning further research there is need to develop comprehensive program with new approach to research methodologies as\(^\text{18}\) -

1) The meditation guide or subject should give the details of process; he is applying internally.
2) In neurophysiology of meditation, just because someone can produce alpha or delta brain waves at will, he or she is enlightened or \textit{jīvanmukta}? The events in neurophysiology take place in the cerebrum and the nervous system which are products of \textit{prakṛti}. They neither prove or disprove the fact of atman-realization.
3) On both ends of spectrum, calibration is in between lowest frequency, (delta brain wave (1-4 Hz) and highest frequency (33-120hz). There may appear a flat rate wave which indicates the subject’s state of consciousness cannot be

\(^{18}\text{Ved Bharati Swami, Future Directions of Scientific Research in Meditation, SRSG Publication, p 7-9.}\)
measured by level of sensitivity for which equipment is calibrated.

In other words, the present technology is capable of measuring first three cittabhūmi-s as kṣipta, mūḍha and vikṣipta and ekāgra partially. But it can give us no indication of niruddha bhūmi or vivekakhyāti or dharmamegha and higher states of consciousness.

4) But on the other hand, it can be proved that Brain functions can be controlled by willpower and so neurological indices may be accepted as indirect proofs of spiritual realization. Also the texts may require fresh translations in the language of modern neuro technology.

5) A much wider program laboratory investigations of different schools, systems and subsystems should be conducted.