

Quantum Coherence in Microtubules.

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• The paper suggests that:

Consciousness may emerge as a macroscopic quantum state from a critical level of coherence of quantum level events in and around a specific class of neurobiological microstructure: cytoskeletal microtubules within neurons throughout the brain.

• Neurons are not just switches. Each neuron is alive - it is a eukaryotic cell with a nucleus and cytoskeleton and exhibits mitotic cell division.

Single eukaryotic cell organisms (Protozoa) such as paramecia show remarkable, seemingly intelligent abilities without the benefit of a single synapse.

• Observations of amoebae hunting food and paramecia avoiding obstacles led DARWIN and others (19th Century) to project human psychology and aspects of consciousness to Protozoa.

• The Fabric of Consciousness may be present in single cells. It may be a quality of all matter atoms and subatomic components.

So, what distinguishes Non-Living from Living?

Many contemporary thinkers feel that Q.M. may provide the answer.

Consciousness may emerge at a critical amount of non-local quantum processing linked to some neural structure.

Cytoskeletal microtubules are the most likely location for such an effect.

The main thesis is

Consciousness is a MACROSCOPIC QUANTUM state driven by neurobiological mechanisms (like coherent firing of distributed neurons) with origins in Quantum Coherence in cytoskeletal microtubules within the brain's neurons.

The microtubule coherence is due to two inter-related mechanisms

- (i) Bose-Einstein Condensates Stemming from 'Fröhlich pumped phonon' mechanism of dipoles in hydrophobic pockets of microtubule sub-units
- (ii) A quantum dynamical system of water molecules and quantized EM field confined inside the hollow microtubular core.

The Human Brain is perhaps the most complex object in the universe.

A trillion (10^{12}) cells.

100 billion of them (10^{11}) are Neurons (found) in every part of the body

The Brain is bilaterally Symmetric; Left and Right hemispheres connected by Corpus Callosum and other axonal bridges.

Base Structure — Medulla — regulates autonomic functions including respiration, Circulation, digestion etc.

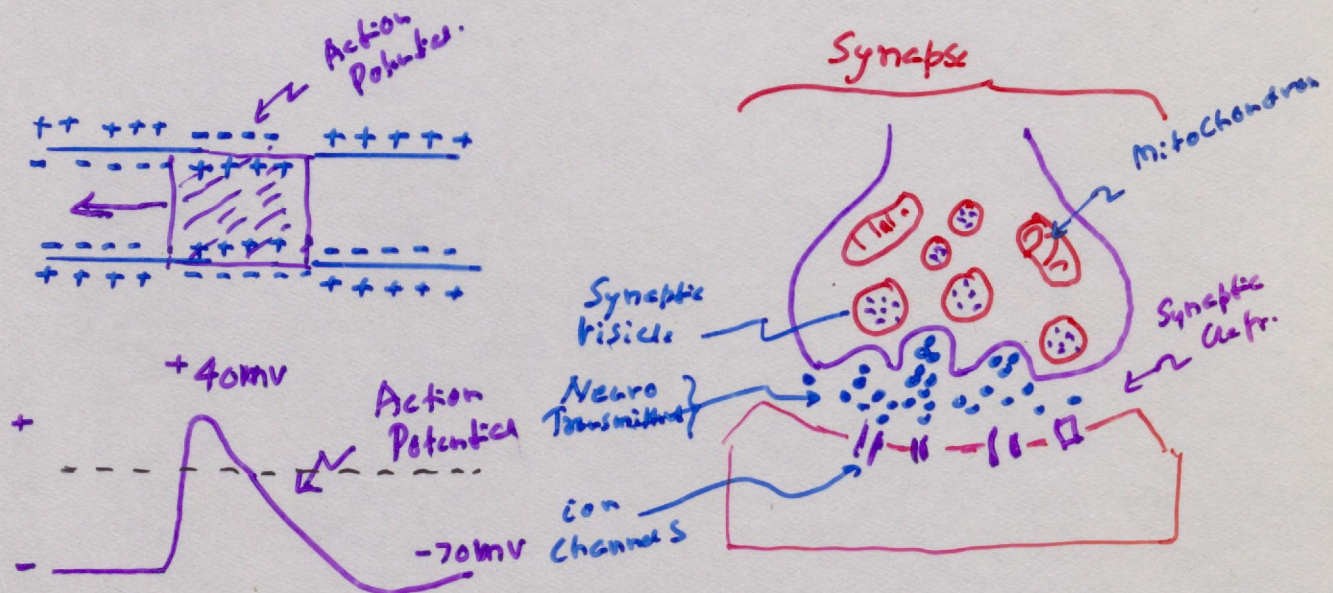
Cerebellum: Coordinates movements

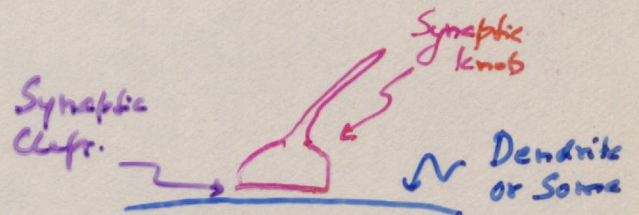
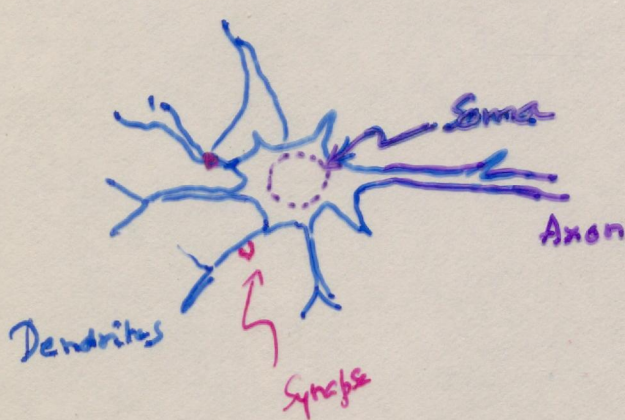
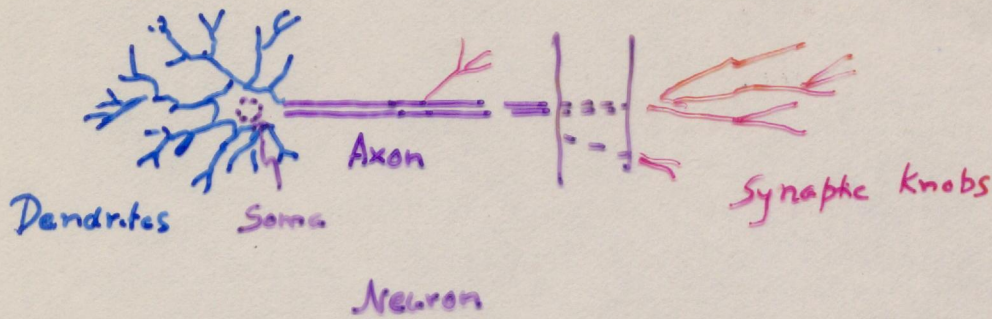
Limbic System (within): emotional behaviour, long term memory

The Surface of the brain is 1.5 m^2 and is 2mm thick is part of the Limbic System.

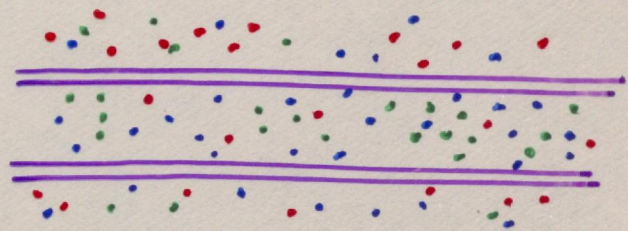
Neocortex: Frontal, temporal, parietal, occipital

Thought and Perception takes place as Nerve Impulses. Called Action Potentials.

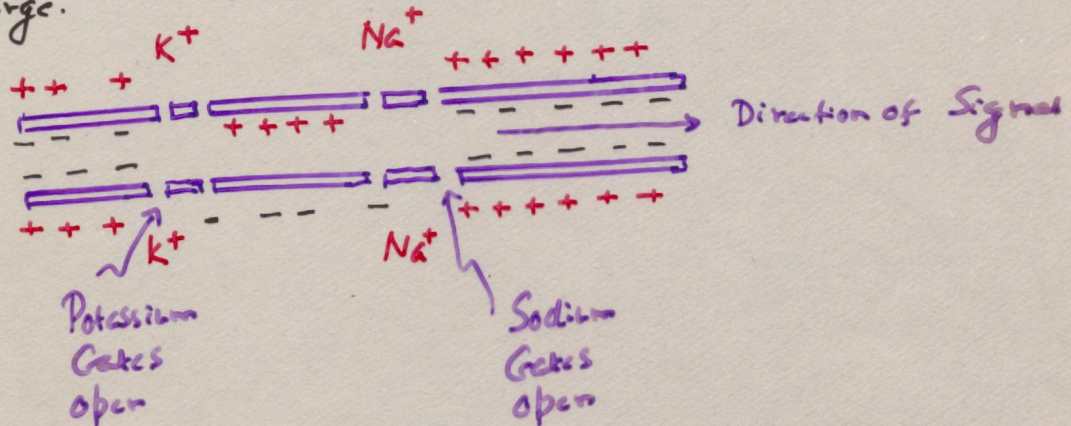




- Chloride -ve ions
- Potassium +ve ions
- Sodium +ve



In the resting state there is excess of Chloride over Sodium and Potassium ions inside giving a Negative Charge, and outside a positive charge.



The Cell membrane is leaky so that ions tend to migrate and neutralize the charge. To compensate for this and to keep a net negative charge there is a 'metabolic pump'

The Living Organism -

* functions as an "organic whole"

(that is the new picture that is emerging
Mac-Wan Ho's article in J.C.S. 1973, No. 3, 1996
(Biology of Free Will)

The organism's activities are fully co-ordinated
from molecular to macroscopic levels.

What is the evidence?

essentially from the chemistry within the organism.

- there is evidence for a net-work of enzyme activity. The metabolic control though distributed is co-ordinated. How?
 - The Cell is not just a bag of dissolved enzymes.
 - The enzymes are bound to intricate "microtrabecular" lattices
 - Metabolites and Water Molecules are structured on surfaces - there are special channels for transport of solutes
- (Such mechanisms had been envisaged by Nechaev 60 years ago. In the last 10 years, they have been established through Electron Microscope and other studies)
- The whole cell is linked up by long range energy continua of mechanical interactions, electric and electro-chemical flows, Protein currents that form Proto-neural network

Whereby metabolism is regulated instantly down to minute detail.

- And more importantly, the cells and tissues are interlinked by electromagnetically induced photons and phonons.

* Global Phase Transitions may be initiated at any point.

- In 1936, Needham had suggested that living systems are liquid crystals.
- Liquid crystals have long range orientation order. They undergo rapid changes in orientation or phase changes due to electric and magnetic fields, Temperature changes, Pressure changes, PH, hydration, concentration of inorganic ions etc.
- It is known to-day that lipids of cellular membranes, all proteins, collagens and macromolecules of connective tissues - are all liquid crystals.
- * In 1993, Ho and her collaborators developed non-invasive optical techniques which provide coloured images of living organism's activities

With this technique it is possible to see the whole of living organism at once from macroscopic activities down to phase alignment of molecules that make up the tissue.

* Brilliant optical colours are generated which are specific to each tissue - depending on the molecular structure and degree of coherent alignment of all the molecules - even as the molecules are moving.

* Ho emphasises that with this technique he can see that :

" The organism is highly interconnected and intercommunicating at all levels from within the cell to the socioecological environment. It is on that account that the organism has freed itself from mechanical control of any kind. It is not a passive object at the mercy of random variations and natural selection but an active participant in the evolutionary drama. In constantly responding to and transforming its environment it partakes in creating possible future generations to come "

* **POLARIZATION AXIS**

These images bring out :

all organisms from Protozoa to vertebrates without exception are polarized along the antero-posterior axis, so that all the colours in the different tissues of the body are at maximum when the a-p axis is

is appropriately aligned and they change in concert as the organism is rotated from that position.

The antero-posterior axis acts as the Optical Axis for the whole organism which in effect behaves as a single crystal.

- This leaves us with ^{out} any doubt that the organism is a singular whole despite the diverse multiplicity and polychromatic nature of its parts.
- The more active and energetic the organism, the more intensely colourful it is -
- It is a vibrant coherent whole.

Quantum Coherence:

The concept of coherence has emerged over the past 20 years to describe the wholeness of organisms

The first detailed theory was by Herbert Fröhlich (1968):

Organisms are made of dipolar molecules packed densely together.

Electric and Elastic forces interact.

Metabolic pumping will excite micromolecules - proteins, nucleic acid as well as cell membranes. across which there is electric gradient of $\sim 10^7$ V/m. These will vibrate and eventually build up coherent excitations - photons, phonons.

- The latter induces a specific collective dynamics called Super-radiance by which coherent photons are created and penetrate without dissipation in the microtubule core in a quantum effect called Self-induced transparency.

[Fröhlich 'Pumped phonon' mechanism :

Proteins undergo conformational changes in 10^{-9} to 10^{-11} sec, coupled to charge distributions such as dipole oscillations, electron movements within specific hydrophobic protein regions. Fröhlich proposed that a set of proteins connected in a common electro-magnetic field such as within a polarized membrane would be excited coherently if ~~biological energy~~ biochemical energy was supplied. -

excitation times 10^{-9} - 10^{-11} sec (GHz) of conformational changes were deduced. Such transitions have been termed by Fröhlich coherent "pumped" phonons. - in quantum mechanical terms - Bose Einstein Condensate.]

Experimental Evidence Claimed:

- GHz-range phonons in proteins
- Sharp-resonant non-thermal effects of microwave irradiation on living cells
- GHz-induced activation of microtubule pinocytosis in the rat brain
- Propagating signals in microtubules

(v) The velocity of light is the top most velocity in the universe. Nothing can move faster than light.

(vi) The mass of a body increases with velocity

(At 0.9 c, the mass increases more than double becomes 'infinite' close to c)

$$m = \frac{m_0}{\sqrt{1 - v^2/c^2}}$$

Einstein developed the General Theory of Relativity by considering 'accelerated motion' and 'Gravitation'. The conclusions of the theory are equally startling:

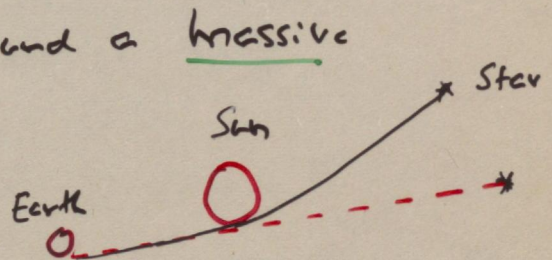
1. Gravity is not a force like other forces, but is a consequence of the fact that Space-Time is not flat (not Euclidean). It is Curved or "warped" by Mass and Energy.

• In fact according to this theory, the motion of the earth round the 'Sun' for example in an elliptic orbit is because of the 'Curvature' of Space around the Sun which restricts the motion of the earth to that particular orbit.

(geodesic is the ellipse)

• Under the action of gravity around a massive object light can be bent

This prediction was verified during the solar eclipse of 1919. Gravitational Lensing - Double, Triple Quasars



• Another prediction of General Theory is that 'time' should appear to move 'slow' near a massive body (the Chicago Water Tower Experiment with Atomic clocks)

• The Cosmological implications - Expanding Universe.

Experience

inanimate

(Matter,
Radiations,
Forces)

(Space
Time
Causality)

(Oneness
example of
a falling stone.)

(**Enlightened**
Quantum Mechanical
Vacuum.
(Creation, Sustainance,
destruction)
Spontaneous
fluctuation)

(W^+ , Z^0 needed the
construction of a
several Billion Dollar
accelerator to be
discovered and add to
the list of particles
in vacuum. There may be
many more!)

animate.

- No new matter
(Same elements)
- No new forces
- What then is
mind (Consciousness) ?
- Neuronal activities
- Crick's Dilemma.
- Oneness - resolves
(Observer = observed)
- Some undiscovered
properties of
AMV may be waiting
to be discovered through
Study of mental
processes.

* What then is Physical Reality?

Matter + Radiation

↓

Elements (Hydrogen to Uranium)

↓

Molecules

↓

Atoms

|

Protons + Neutrons + Electrons

QUARKS

+ LEPTONS.



{ Space - Vacuum - (as defined by Quantum Mechanics)
all Negative Energy States fully filled

Matter - Curved Space.

The Physical Substratum is Q.M. Vacuum - just one entity - **(Not Q.M. Equation)**

Access to this Physical Reality is somehow through
Human Consciousness

Does it help to reduce Life, Consciousness, mind etc., to the motions of subatomic particles similar to matter?

This would give no new insight from the point of view of REALITY.

- Consequences of Relativity Theories.

Ideas of Space, Time, Mass, Energy, Force, Simultaneity, all undergo complete transformation.

CONCEPTS CHANGE.

- New Experimental Discoveries

X-rays, Radio Activity, Electron, Proton the Nucleus

- Breakdown of Classical Theories.
- Quantum hypothesis - Quantum Mechanics
- Discoveries in Cosmic Rays of new elementary particles and high energy processes - Meson Production
- Cascades - EM and Nuclear cascades.
- Dirac's theory of the electron-
- Anti-particle discoveries.
- Ramification of EM forces and Nuclear Forces. Exchange Forces - Virtual particles.
- The Role of Quantum Mechanical Vacuum in creation of particles and forces.
- Grand Unification of forces ?

These experimental discoveries and the theoretical formulations changed entirely our concepts of

- Space, Time, Mass, Energy, Vacuum, Force etc.
- The Quantum Mechanical Vacuum (the Dirac vacuum) comes to the fore not only as the hidden substratum, but as the very content and means of all physical activity

[The quotations from Einstein and Dirac]

Force : Mediated by the Creation and annihilation of virtual pairs.

Mass : Curvature of Space-time Continuum.

Vacuum: Repository of all particles - or waves corresponding to all particles

Creation: (i) By Spontaneous fluctuations
(ii) By deposition or availability of energy from outside.

16th. Chapter. Bhagavad Gita.

- अन्नयं स्वसंशुद्धिं ज्ञानयोगं व्यवस्थितिः
दानं दमनं यज्ञश्च स्वाध्यायस्तप आर्जवम्
- अहिंसा सत्यमक्रोधस्त्यागः शान्तिरपैशुनम्
दया भूतेषु कोटुर्ष्वं मार्दवं ह्रीरचापकम्
- तेजः क्षमा धृतिः शौचमद्रोहो नातिमानिता
भवन्ति संपदं देवीमभिजातस्य भारत
- दुश्शो दूर्पोत्रिमानस्य क्रोधाः पारुष्यमेव च
अज्ञानं चाभिजातस्य पार्थ संपदमासुरीम्

Charles Darwin (1809 - 1882)

Tribute to Nature

"The more I study Nature, the more I become impressed that the contrivances and beautiful adaptations, slowly acquired through each part occasionally varying in a slight degree ... transcend in an incomparable manner the contrivances and adaptations which most fertile imagination of man could invent"

Darwin had also foreseen the ultimate fate of his theory:

In his book "Origin of Species" he wrote:

"... I look at it absolutely certain that very much in the "Origin of Species" will be proved rubbish, but I expect and hope that the framework will stand."

The dilemma of Francis Crick:

In his recent book "The Astonishing Hypothesis" the Nobel Laureate Francis Crick starts out with his astonishing hypothesis:

"Your joys, and your sorrows, your memories and your ambitions, your sense of personal identity and your free will are in fact no more than the behaviour of a vast assembly of nerve cells and their associated molecules"

Well, at the end of 262 pages of the book in which he has elaborated in a masterly way how this hypothesis is supported by neurosciences he remarks:

"The astonishing hypothesis may be proved correct. Alternatively some views close to religious one may become more plausible. There is always a third possibility that the facts support a new way of looking at the mind-brain problem that is significantly different from the rather crude materialistic view many neuroscientists hold today and also from the religious point of view. Only time and much more scientific work will enable us to decide."

Quantum Mechanical Model of Consciousness.

- David Bohm [in his book Quantum Theory]

" Thought Processes and Quantum Systems are Analogous in that they cannot be analysed too much in terms of the distinct elements, because the intrinsic nature of each element is not a property existing separately from and independently of other elements, but instead a property that arises partially from relations with other elements."



An electron for example is just not an electron - Shifting energy patterns shimmer around it - Unpredictable appearance of photons, protons, mesons, even other electrons - all the paraphernalia of the subatomic world latches on to it like an intangible evanescent cloak. ... quantum expressions of fields ... in the case of hadrons it is even more blurred

- Roger Penrose [in "Mind Braves"]

" ... Perhaps it is not too fanciful to suggest that quantum correlations could be playing an operative role over large regions of the brain. Might there be any relation between a "State of Awareness" and a highly coherent quantum state in the brain? Is the oneness or globality that seems to be a feature of consciousness connected with this? It is too tempting to believe so."

Scientific frame-work for explanation of Consciousness.

-
Knowledge is an Ocean into which many Streams contribute. Science is one of them.

Simple, elegant and most Comprehensive definition of Science:

" Science is the attempt to understand the structure of our universe and how it works including ourselves "

Charles Townes.

Science is valued for its

- (i) Practical advantages
- (ii) Disinterested curiosity gratified
- (iii) Contemplative imagination with objects of great aesthetic charm

J.W.N. Sullivan

The Brain and its accessories

CORTICES
LAYERS
NEURONS
GLIAL CELLS
BLOOD STREAMS
SENSORS

Electro Chemical
Processes
Chemical processes
Electrical
E-M waves
Jumping electrons
Quantum processes
⋮

⇒ Consciousness -
interprets the
signals and gives
MEANING to them
and generates
appropriate action.

HOW ?

Signals to
Consciousness

* TRANSCENDENCE

* These Transcendences may
be required because of
human mental limitations
caused by evolution -
adaptation to middle size
phenomena

[Max Delbrück]

↓
Evolutionary effect.
(Compete and Survive)

CREATION OF
MATTER AND
RADIATION AND
FORCE FROM
VACUUM -

Again by

* TRANSCENDENCE -

Vacuum processes
Creation of particles
and virtual particles.

Workshop on:

Ego, Embodiment and the Sensory Motor System
Creative interaction between Indian Philosophy
Cognitive Science and Phenomenology.

- Touches upon some of the most fundamental issues that have been the concern of Intellectuals from the dawn of civilization. - Who later became philosophers, Scientists, medical men, psychologists, neuroscientists, and so on.

The six aspects concerning human beings are

(i) Life - What is it. What exactly distinguishes living from the Non-Living.

(ii) Body - Birth, Growth, Death. - function of time.

(iii) Mind - The Cartesian Distinction.
Hindu philosophy - Mind is one of the organs like the other sensory organs.
or Buddhist philosophy Mind = Consciousness -
Sensations, perceptions, thought, knowledge, ...
most importantly "Will"

(iv) Ego - Self-Consciousness? Ego Maker?

According to Shankara (Vivekananda)

(Manas, Me, Me) " Know that egoism it is egoism which identifying itself with the body becomes the "doer" or the "experiencer" and in connection with the Gunas such as Sattva assumes the three different states (Waking, Dream, Sleep)
When sense objects are favourable it