

Journal of Consciousness Studies

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Classical Mechanistic World View (1400 - 1900 A.D)

127 - 151 AD } Ptolemy - Geocentric World.
Observations at Alexandria } proposed

→ 1473 - 1543 Nicholaus Copernicus - Heliocentric World View

Church against Copernican theory
Bruno burned at the stake.

1546 - 1601 Tycho Brahe } observations
1564 - 1642 Galileo } Support Copernicus.
1574 - 1630 Kepler } Kepler's laws.

Galileo: Pure logical thinking cannot yield us any knowledge of the empirical world. Mathematics in addition to observation provides the true key to nature.

1642 - 1727 Newton :
 • Formulated solid framework of classical physics.
 • Introduced mathematics into physics. - equations
 • Experiment - final test.
 • Believed in - Absolute Space, Absolute Time,
 • All matter made of indestructible particles.
 • Gravitational force - instantaneous transmission
 • Corpuscular theory of light.

1749 - 1827 Laplace
 5 volumes on Mécanique Céleste.

Laplacian determinism

Napoleon asks Laplace about God.
Laplace replies, he has no need for that hypothesis

Developments in Chemistry -
 Conservation Laws; Entropy

Proust's Hypothesis :

• All Matter consists of Hydrogen

1627 - 1691 Boyle

1733 - 1804 Priestley - oxygen

1731 - 1804 Cavendish

1743 - 1794 Lavoisier

1754 - 1826 Proust

1400-1900 (Contd)

1791-1867 Faraday

Magnetic Induction → Electricity
Dynamo - motor.

1831-1879 Maxwell

(Ethen?)

EM waves.
Electricity and Magnetism unified.

Light, UV, X-ray, γ-ray,
Radio, IR, ... all EM waves.

1857-1894 Hertz.

EM waves produced in the laboratory

- J.C. Bose }
• Marconi }

Transmission of EM waves.

1880 Michelson. Morley Experiment.

Hat-trick years

- (Rontgen) x-rays • 1895
- (Becquerel) Radio-activity • 1896
- (Thomson) electron • 1897

- No Relative motion between earth and ether.

- Velocity of light is the same whether the earth is moving towards or away from the source.

Parting gifts of the 19th. Century.



Quantum Theory.

Matter ≡ Energy } → $E = mc^2$
Relativity. (1905)

Einstein:

Radical Departure from Common-Sense Everyday ideas on

Space, Time, Matter, energy Causality

" We can do away with the ether.
the velocity of light may be considered as a Constant of Nature independent of the source or receiver as the Michelson-Morley experiment dictated.

But, we have to give up our conventional idea of Space and Time."

1890-2000 A.D.

- The Scientific and Technological tools
- Electronic Devices - Radio, TV, Radar... Computer
- X-ray Machines
- Particle Accelerators
- Atom Bomb, Hydrogen Bomb, Neutron Bomb
- Refrigerators
- Superconducting Magnets
- Lasers
- Space Vehicles
- Tomographs.
- Aeroplanes
- Polaroid Cameras
- Digital Cameras

- Revolution in :
- Transportation
 - Communication
 - Health Services
 - Quick Transmission of Knowledge
- } Positive Side
- Mass Destruction.
 - Pollution
 - New Diseases
- } Negative Side.

1. Pure Chance Discoveries:

Magnetism } Systematized by Newton,
Electricity } Benjamin Franklin, Volta, Ohm
Gravity } Ampere, Faraday

- Magnetic Induction.
- Production of electricity - Dynamo.
- Motors...

2. Experiment - Theory - Experiment.

Light } Reflection, Refraction, Diffraction
Newton, Huygens (Wave Theory)

EM Waves } • Maxwell's Theory
• Production of EM Waves - Hertz.

Ether Theory } • Radio Wave Transmission - Marconi }
J.C. Bose }

Velocity of } • Michelson-Morley Experiment -
light. } Constancy of Velocity of light
Einstein's Theory of Relativity -

Black body } • Quantum Hypothesis - Max Planck
Spectrum. }
Spectral lines } • Theory of the Atom - Bohr.

* Odd behaviours of Simple Instruments.

Discovery of Cosmic Rays : { Leaking Charged
Metal Sphere
Charged Electroscop

further discoveries of
mu-mesons } Positrons pair production
pi-mesons } Hyperons Meson "
k-mesons } Strange Particles.

Research for 100 years pushed both balloons,
rockets, satellites, at mountains, underground,
underwater, under ice.

(Simharta Dweep)

* Serendepitous Discovery :

Discharge Tube }
Studies

X-rays,
electrons.

Radioactivity
{ Rontgen
Belgared.
Thomson
alpha, beta, gamma,
protons

Scattering of
alpha-particles }
|

Nucleus
|
Bohr's Theory
of the Atom.

Rutherford.

Astronomics }

Radio (Jansky) { Penzias
Microwave Radiation. } Wilson
X-ray Giacconi, Rossi, Gursky
Pulsars. Hewish

Expanding Universe. Hubble.

Einstein

- Science can ascertain only What is, but not what should be.
- Therefore all Value judgements remain Outside the domain of Science.

Heisenberg

- Modern physics has perhaps opened the door to a wider outlook on the relation between Mind and Reality.

Schrödinger

"The reason why our sentient, percipient and thinking 'ego' is met nowhere within our scientific world picture can easily be indicated in seven words: because it is itself the world picture. It is identical with the whole and therefore cannot be contained in it as part of it"

Question: There are multitudes of these egos, but the world is ONE. How?

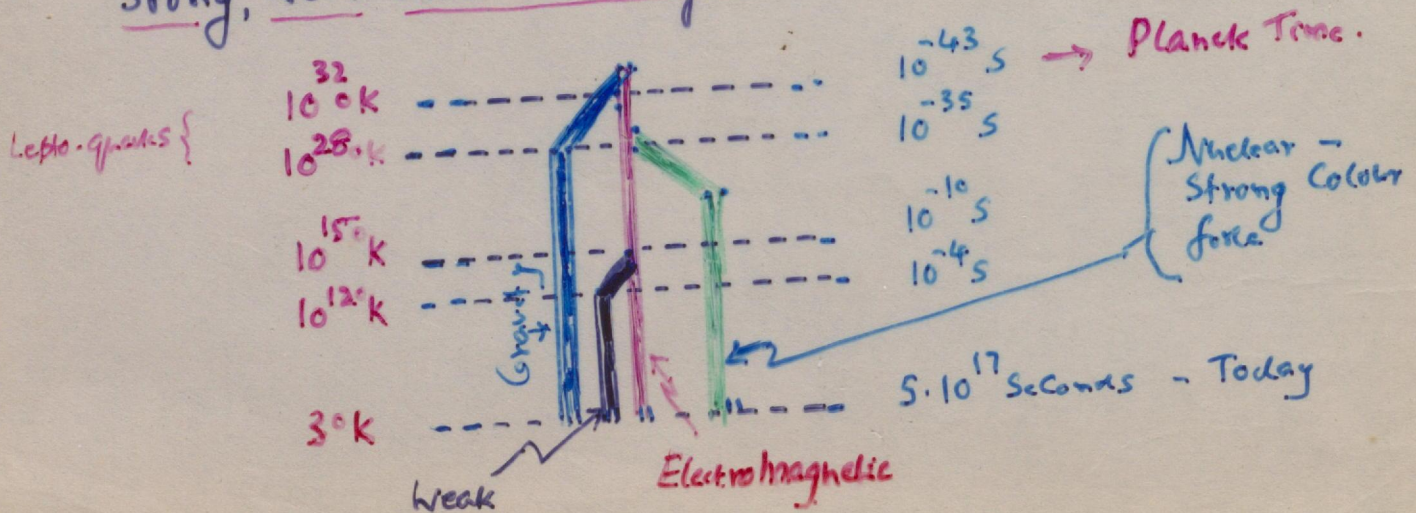
Sch: There is obviously one alternative, namely the unification of minds or consciousness the doctrine of Upanishads.

- The mass of the Leptoquark is estimated to be $10^{15} \text{ GeV}/c^2$ - so large that no terrestrial accelerator has ever produced this particle

- But in the very first few moments of the universe when the temperature is $\sim 10^{320} \text{ K}$ it is conceivable that the Leptoquarks could have been produced

- If these unification ideas are right then the universe goes through "Phase Transitions" at specific temperatures. One such transition could have occurred at $3 \times 10^{150} \text{ K}$ - At temperatures above this there would be no distinction between Weak and Electromagnetic Interactions - the weak interactions will obey the inverse square law like EM interaction, and about the same strength. Properties of the interactions change

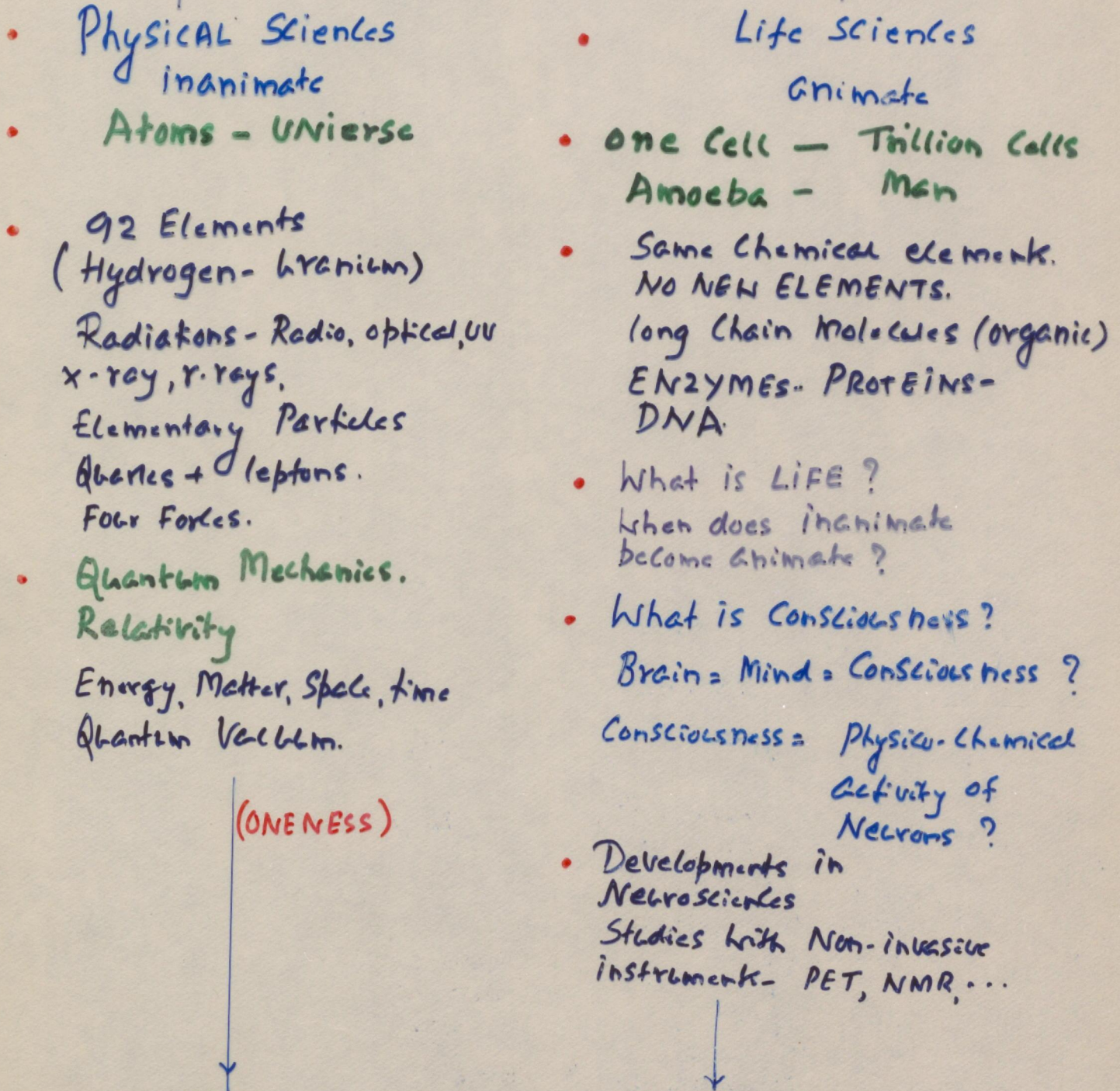
- Similarly there could be another phase transition at say 10^{280} K - the unification of the Strong, Weak and Electromagnetic Time from Big Bang.



SCIENCE AND CONSCIOUSNESS

(Philosophy → Science)

SCIENCE



- Physical Sciences
inanimate
- Atoms - Universe
- 92 Elements
(Hydrogen - Uranium)
- Radiations - Radio, optical, UV
x-ray, γ-rays,
Elementary Particles
Quarks + leptons.
Four Forces.
- Quantum Mechanics.
Relativity
Energy, Matter, Space, time
Quantum Vacuum.

- Life Sciences
animate
- One Cell - Trillion Cells
Amoeba - Man
- Same Chemical elements.
NO NEW ELEMENTS.
long chain molecules (organic)
ENZYMES - PROTEINS -
DNA.
- What is LIFE?
When does inanimate
become animate?
- What is Consciousness?
Brain = Mind = Consciousness?
Consciousness = Physico-Chemical
Activity of
Neurons?
- Developments in
Neurosciences
Studies with Non-invasive
instruments - PET, NMR, ...

Physico-Chemical Activity of Brain -
Neurons
Action Potentials, Neurotransmitter Chemicals

- Connection between Sensations (Qualia) and
Neuronal States - Correlations.
- Binding Problem - Oscillations (EM, Acoustic)
- MONISM - ONENESS -

Astronomical Techniques - Milestones.

- * Optical astronomy - naked eye - Galileo - ... Hubble - Palomar ... Space Telescope.
- * Telescope + photographic plate } fainter objects
Structures
Variability
- * Telescope + Spectroscope + photographic plate } Temperatures, Pressures,
distances, velocities, ...
- * Telescope + CCD - Lot in this workshop.
Illustration of the Comet.

* Infrared Astronomy

Ground based - Leighton - Neugebauer 1.5 m telescope
(Caltech Effort)

- * 0.7 - 1.1 μ Photographic
 - * 1.1 - 4 μ - Lead Sulphide
Indium Antimonide (500k)
 - * > 4 μ Germanium-Gallium (20k)
- Manna Kea (Hawaii) 4200m NASA 3m
UK 3.8m
- Air Force Rockets 11, 20, 27 μ .
- Balloons > 70 μ * Himalayan Telescope?
- IRAS (1983) 8 - 120 μ

* Radio Astronomy - Fall out from an entirely different field of Research.

Karl Jansky - Radio noise - atmospheric static
"Eight Large Metal Hoops Supported on
Wooden Frames Rotated slowly on a
Set of T-model Ford wheels"

Creation and Sustenance of the Universe.

What does the Universe consist of?

How was the Universe created?

How is it sustained?

What will be its end?

These questions have been asked for millenia.

The most popular theory to-day is the Big Bang Theory essentially because of three important

- Observations.
- (i) the Universe is expanding
 - (ii) it is filled with microwave radiation corresponding to a universal temperature of 30k
 - (iii) the ratio of He to hydrogen is $\approx 22/78$.

- The Big Bang took place ≈ 20 billion years ago.
- The laws of physics hold upto $\approx 10^{-43}$ seconds of creation.
- Space, Time, laws, Constants of Nature, all created at Big Bang.
- No Space, No time before -
- Infinite Energy - at a point - explodes spontaneously. Space, time created.
- Out of Space - by fluctuation - all matter subsequently created - at temperatures higher than 10^{30}° .

• Evolution of the Universe

particles

atoms

molecules

Stars - Galaxies

Stellar explosions

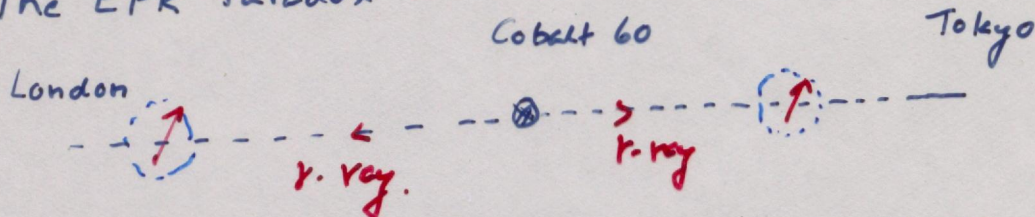
Heavy elements

Planets -

Earth -

- Is Reality Non-Local?
- Does what happens here depend upon what happens far away?

The EPR Paradox -



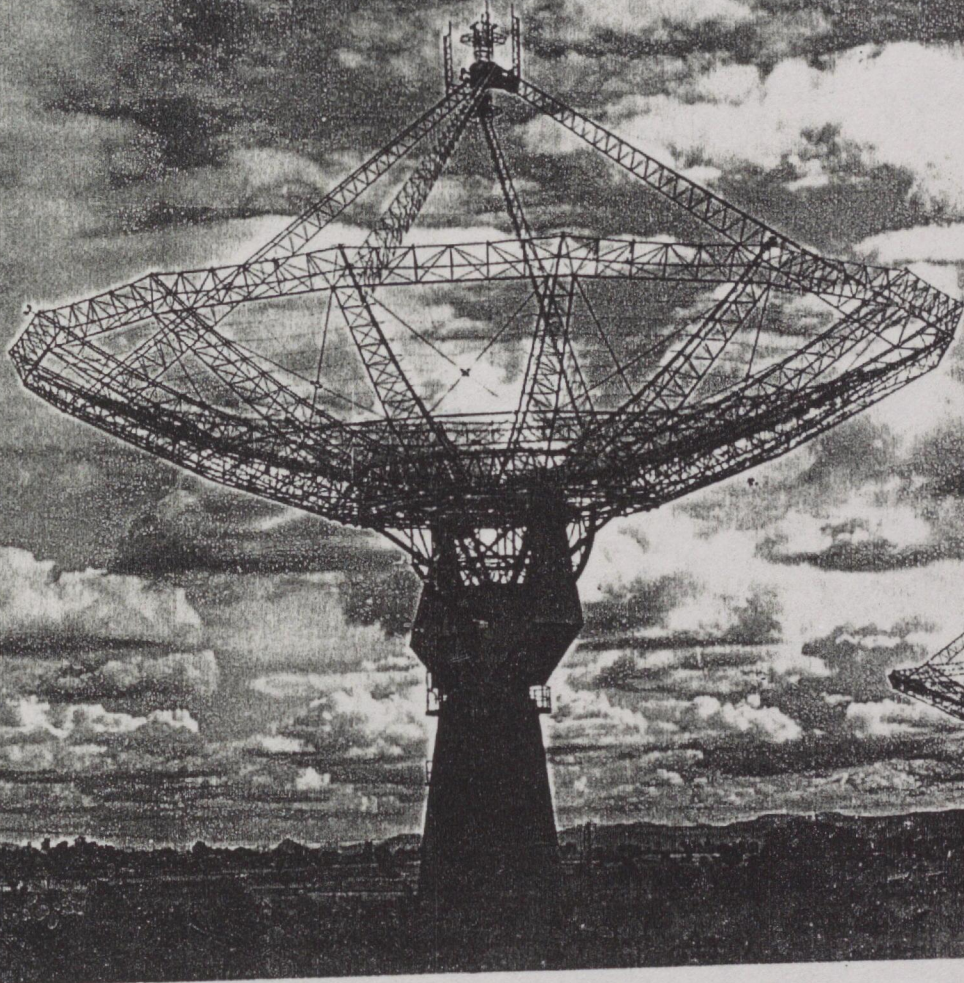
- Simultaneous Emission of two γ -rays in opposite directions by the decay of a Cobalt-60 Nucleus. ^{Positronium etc.}
- QM says that this is a Coupled System and the Polarization of the two γ -rays must be perpendicular though the plane of polarization is random.
- Supposing we measure the plane of polarisation and determine its direction using the γ -ray that has reached say London.
- According to Q.M. this determines the Polarisation of the γ -ray at Tokyo even without measurement or observation.
- Is this not a Contradiction of the Copenhagen Interpretation of QM that Reality is known only on observation?
- Otherwise, if it is not predetermined (without observation) information must have travelled at Superluminal Velocity (Some how!) from London to Tokyo. This Contradicts Relativity.
- Experiments seem to support the Copenhagen Interpretation according to which QM is Complete.

The Crab Nebula

- 1054 A.D. A Star explodes in the Constellation Taurus
Chinese Astronomers keep record.
- 1850's Lord Rosse sketches the Nebula.
Gives the name 'Crab'
- 1913 Doubling of all Spectral Lines
First indication of Doppler Shift.
- 1930's Expanding Hot Nebula established
through repeated photographic exposures
- 1950's Radio and Polarized optical emission
Suggest 'Synchrotron' emission. -
High energy electrons spiralling round
magnetic fields. Schlovsky suggested
TeV gamma ray emission.
- ~~1642.~~
1962 Discovered as an X-ray source. Neutron Star
hypothesis that was proposed was soon
discredited on the basis of size measurement
of the X-ray source through lunar occultation
1968. Radio Pulsar discovered - 33 ms -
Neutron Star.
- 1970 } Searches for TeV, PeV emissions.
1990 }
- 1991 } Definite Evidence for Steady TeV.
Episodic Pulsed PeV.









Two Categories of philosophers emerged over the Centuries:

Rationalism

{ Descartes (1596-1650) } Mathematicians
Leibniz, (1646-1716) } (Non-Scientist)
Spinoza, (1623-1677)
Kant (1724-1804) } Astronomer



All knowledge obtained through direct observation of nature through senses can be deceptive.

All knowledge must be derived by contemplation.

True statements about the material world can be found by power of reason without sense experience.

Locke: Intuitive Truths
Self, God, Mathematics.

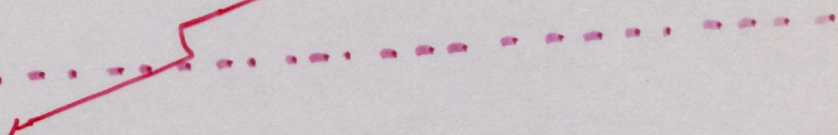
Godel: • Mathematics can never prove that mathematics is free from internal self-contradictions.
• Certainty is an illegitimate concept.

Empiricism.

{ Francis Bacon (1561-1626)
Locke (1632-1706)
Berkeley (1685-1753)
Hume (1711-1776)
Whitehead
Russel



- The only way to discover facts about the universe is to go into the outer world and search for them.
- Certain truths, like those of pure mathematics can be known by intuition.



* Very Early Western Philosophers:

• Thales of Miletus (640-546 BC)

Ionian Philosopher: • Collect Substratum of facts to build objective knowledge. Facts should be independent of the judgement of individuals.

• Pythagoras (570-501 BC):

• The structure of the physical universe is deeply related to the structure of mathematical universe. Number is the substance of all things. $\sqrt{2}$ - not possible to express as ratio of integers - this made him lose his confidence.

• Leucippus and Democritus (470-400 BC)

• Everything in the world consists of "atoms and void"

• Epicurus (341 BC)

Number of atoms 'infinite' 'void' also 'infinite'

• Zeno

World is moving towards perfection, designed by God. Man can achieve partly this perfection.

* Medieval philosophers.

• Socrates (469-399 BC)

• Plato (429-347 BC)

• Aristotle (384-322 BC)

Placed mental capabilities at a higher pedestal and firmly believed that mathematics provided a crucial key to the secrets of nature.

(Reason + Revelations) ←

No love for experimental knowledge.
Holistic, Teleological outlook.

Philosophers of the Renaissance Period

• Hobbes (1588 - 1679 AD)

Defined philosophy as study of effects from causes and of causes from effects.
Pure materialist.
Man = animal with a material body; thoughts, emotions etc are mechanical motion of atoms.
No free will; everything pre-determined.

• Descartes (1596 - 1650 AD)

Founder of Analytical Geometry.
(Cartesian System of Coordinates)

Despite all emphasis on matter and subtle matter Descartes believed that the external world is inferential and not one of direct perception.

∴ He is regarded as a founder of Idealism also.

"Cogito ergo Sum"
= "I think, therefore I am"

There can be Being - Existence without thought.

∴ There could be an external world.

- Mind is to think. Matter to occupy space.
- Mind is made of subtler matter.

His followers said "God had so ordained that activities of the mind correspond exactly to that of matter in synchronisation."

Leibniz (1646 - 1716 AD)

Mathematician.
Contemporary of Newton.

Inventor of Calculus

Soul = psychic unit = monad
Infinite number of monads.

God created mind and matter in such way each follows its own laws but move in perfect agreement.

[philosophy is the discipline in which you kick up lot of dust and then complain you can't see!]

- **Benedictus Spinoza:** (1632-1677 AD)
 - Spinoza reduced duality world and God to Universal Unity (Substans)
 - Standing under all phenomena, supporting and giving them reality
 - The substans was God for him. Closer to God, the better one understands the Universe.
- **Kant (1724-1804):**
 - Object and its mental picture entirely different. Since the frames through which we perceive are different.
 - 'the thing in itself' not accessible
 - 'a priori' knowledge (inborn) is superior to 'a posteriori'.
- Descartes, Leibniz, Spinoza and Kant classified as rationalists.
 Statements regarding material world can be made only through power of reason without sense experience.
 - All knowledge through contemplation only.
- **Locke (1632-1704):**
 - At birth human mind is Tabula Rasa - blank tablet.
 - Then ideas of reflection.
 - All knowledge - only ideas
 - No God, no Nature. only ideas

Berkeley
1685-1753)

: There is nothing in the 'thing'
which is not reducible to an
idea or bundle of ideas.

" All the Choir of heaven and
furniture of earth, in a word all
those bodies that compose the mighty
frame of the World, have not any
Substances without the mind....
So long as they are not actually
perceived by me or do not exist in
my mind or that of any other
Created Spirit, they must either have
No existence at all or else Subsist
in the mind of some Eternal Spirit."

Hume (1711-1776) : Questioned the basis of mind.

" We are immediately aware of
feelings, Sensations, Volitions,
Cognitions - pleasure and pain, love and
hatred, sound and colour, but we
never come across the supposed
Substrate of feelings - the mind.

... there is neither mind nor matter
all is idea changing every moment.
No Substance, No Reality, No
permanent immutable element
... it is impossible to penetrate into
the causality of observable
phenomena."

An extreme
Skeptic!!

Leibniz (1646-1716)

Contemporary and Professional
Rival of Newton.

In the beginning God Created Mind and Matter, in such a way that each can follow its own laws and yet the two move in the same perfect agreement as would prevail "if God were for ever putting his hand to set them right"

Obviously so great a Craftsman as God could make Caesar's body and pre-arrange its atoms so that it should go to the Senate house at such and such an hour on the Ides of March...

[In this way every mind becomes an automation]

• Kant (1724-1804)

An object and its mental picture are entirely different in nature; there is no reason that the mental vision that the mind constructs out of the electric currents in the brain should resemble those objects that produce the currents.

"the thing in itself" is inaccessible to our senses. Our minds are responsible for the "frame" through which we perceive external objects.

Kant asserts that the external world exists in itself, but appears to us in a way that is determined by our minds. This view is called "Critical Idealism" and differs from "Idealism" according to which reality is denied to the external world.

Kant (Contd).

The Outer World provides us with Confused Mass of information. It is the mind that sorts out these into some kind of order

- a-posteriori and a-priori Knowledge
- In the inborn human mind there are a number of ready made principles or facilities to discover truths about the universe.
- It should be possible to construct "a pure science of nature" which would be independent of all experience of the world. — Un-contaminated by the errors and illusions of observations
- a-posteriori knowledge is a result of experience of the world.
- a-priori knowledge — previously to and independent of the actual experience of the world.
- a-priori knowledge is applicable to every possible universe and not necessarily to the one that we observe

[An important question is, when a child is born is its mind blank or filled with certain knowledge?]

Change in the aim of philosophy

(Sir James Jeans in "Physics and philosophy")

- " The ancient philosophers pursued their studies in the hope of finding a lantern which should guide their feet along the best path in their journey through life, the philosophers of the 17th and 18th Centuries in a fixed determination to find evidence that this journey ended in a life to come.

This humanistic tinge has taken a long time to disappear, but has almost done so in recent years.

Philosophy has become less concerned with ourselves, and more concerned with the universe outside."

In Bertrand Russell's words

" Man on his own account is not the subject matter of philosophy. What concerns philosophy is the universe as a whole.

Man demands consideration solely as the instrument by means of which we acquire knowledge of the universe.

We are not in a mood proper to philosophy so long as we are interested in the world as it affects human beings.

The philosophic spirit demands an interest in the world for its own sake."

Einstein:

Is a scientist (a) realist? (b) idealist?
(c) positivist (d) platonist?
Pythagorean?

E: A scientist must appear to the systematic epistemologist as a type of opportunist:

- He appears as a realist in so far as he seeks to describe a world independent of acts of perception;
- as an idealist in so far as he looks upon the concepts and theories as free inventions of the human spirit (not logically derivable from what is empirically given);
- as a positivist in so far as he considers his concepts and theories justified only to the extent to which they furnish a logical representation of relations among sensory experiences.
- He may even appear as a platonist or a pythagorean in so far as he considers the view point of logical simplicity as an indispensable and effective tool of his research.

Revolutionary changes in these concepts and methodologies at the end of the 19th Century and the beginning of this Century (20th), forced by new observations

- Spectral Lines, Radioactivity, Constancy of the velocity of light,

- Advent of Relativity and Quantum theory :
 - Space-time Continuum (Four Dimensional Space)
 - $E = mc^2$
 - Elongation of Space and Contraction of time
 - Equivalence of acceleration and gravity
 - Mass = Curvature of Space
 -
 - Wave/particle duality - observer based reality. (Theory dictates observation - Einstein)
 - Probabilistic interpretation
 - Superposition principle - (collapse of Ψ)
 - Non-locality
 - Pauli's exclusion principle
 - Quantum mechanical vacuum.
 - Antiparticles
- The way of looking at things changed drastically.

Originally, the aim of Physics at its most fundamental level was not so much to describe the world but explain why it is the way it is. But it changed so much that
- Dirac said: Provision of pictures is not the aim of physical science.

Explanation became mathematical and abstract and drifted far away from everyday experience.

20th. Century Developments in Physical Sciences

* Special Theory of Relativity:

- (i) There is no absolute space; no absolute time; space and time have to be fused into four dimensional space-time continuum.
- (ii) In a moving medium space contracts and time dilates - the extent depends on the velocity.
- (iii) The idea of simultaneity - that two events take place at the same time has no longer any meaning.
- (iv) Mass and Energy are equivalent
 $E = mc^2$
- (v) The rest mass of any body increases as its velocity increases and becomes infinite at the velocity of light.
Nothing physical can move faster than light.

• Practically all these are against common sense - on which old physics was based.

(TRANSCENDENCE in Physics)

General Theory of Relativity

- Space-Time Continuum introduced in Special Theory, was shown in General Theory (accelerated frame of reference) not Euclidean.
- For example, the three angles of a triangle do not add up to 180° .
- The Space-time is curved around a massive object and the curvature increases with mass.
- Einstein's gravitational laws define the structure of the gravitational field -
- The earth going round the Sun in an elliptic orbit is not looked upon as due to gravitational force of the Sun, but as a consequence of the structure of the gravitational field determined by the mass of the Sun and of the earth.
- Light bends in a gravitational field.
- Time slows down in the proximity of a gravitating body

All these features have been verified experimentally.

• Einstein's universe :

- Non-Euclidean and Finite - but unbounded.
- No straight lines - only great circles in Four Dimensional Space-time Continuum. (Geodesics)

• Sir James Jeans :

" A Soap-bubble with Corrugations on its Surface ;

The universe is not the interior of the Soap bubble, but its Surface.

We must remember that while the Surface of the Soap bubble has only two dimensions, the universe bubble has four - three dimensions of space and one dimension of time. And the substance out of which this bubble is blown, the Soap-film, is empty space welded on to empty time"

- The Geometry or Curvature of Space is determined by its material content.

- Average density $\sim 10^{-30}$ gms/cc.

- Radius of the universe = 35 billion l.y.
= 2.1×10^{23} miles

- To go round the universe light ray travelling at 186,000 miles/sec, will take 200 billion years

* **John Archibald Wheeler: Participatory Universe**

- "The language of Eastern Mystics and Western physicists are becoming similar"
- "May the Universe in some strange sense be brought into being by the participation of those who participate!"
- "The vital act is the act of participation."
- "'Participator' is the incontrovertible new concept given by quantum mechanics. It strikes down the term 'observer' of classical theory, the man who stands behind thick glass wall and watches what goes on without taking part. It cannot be done, quantum mechanics says"
- "The key to understanding the Universe is you"
- "The distinction 'in-here', 'out-there' may not exist. What is 'out-there' apparently depends in a rigorous mathematical sense as well as philosophical one, upon what we decide 'in-here'"
- "What we experience is not external reality but our interaction with it"

Heisenberg :

" What we observe is not nature itself, but nature exposed to our method of questioning "

" The wave function does not represent a real situation, but our knowledge of a physical situation.

The wave function collapse is not an actual physical event, but represents the change that occurs in our knowledge when we become aware of the result of measurement

BELL:

The World is filled with innumerable non-local influences.

Furthermore these unmediated connections are present not only in rare and exotic circumstances, but underlie all events of everyday life.

Non-local connections are ubiquitous because Reality is non-local.

Physics and Consciousness

1. Who are all interested in the Study of Consciousness
2. Definition of the problem of Consciousness - What is it that we are looking for as explanation.
3. The Neuroscientists' Approach
Neuronal Correlates.
4. Where does Physics come in
5. The physicist and explanation of Natural phenomena :
Reduction - Holism
Classical - Quantum
6. QM-Vacuum - Ultimate reality ?
Urstoff

Physics, the Universe and Consciousness

- * Nature and Scope of Scientific explanations - Limitations
- * Hierarchy in Scientific Explanations
- * In this hierarchy "Physics" has the job of providing explanations at the most fundamental levels
- * Journeys in the Reductionistic Trains into the micro and macro universes in opposite directions (Glashow Snake) only to meet in the horizon of Grand Unification and inevitability of a "holistic" approach.
- * The analysis of the phenomenon of a "falling Stone" to illustrate the above scenarios

• The Expanding Universe

• Hubble - Receding galaxies.

• Big Bang Creation.

• Einstein's Blunder!

• The Early Universe.

• **SPACE = VACUUM = DIRAC SEA.**

• Relativity + Quantum Mechanics.

• The Positron - Anti-electron.

• Spontaneous pair production.

• Cascades in matter.

• Production of elementary particles

• The Full implications of Dirac Sea

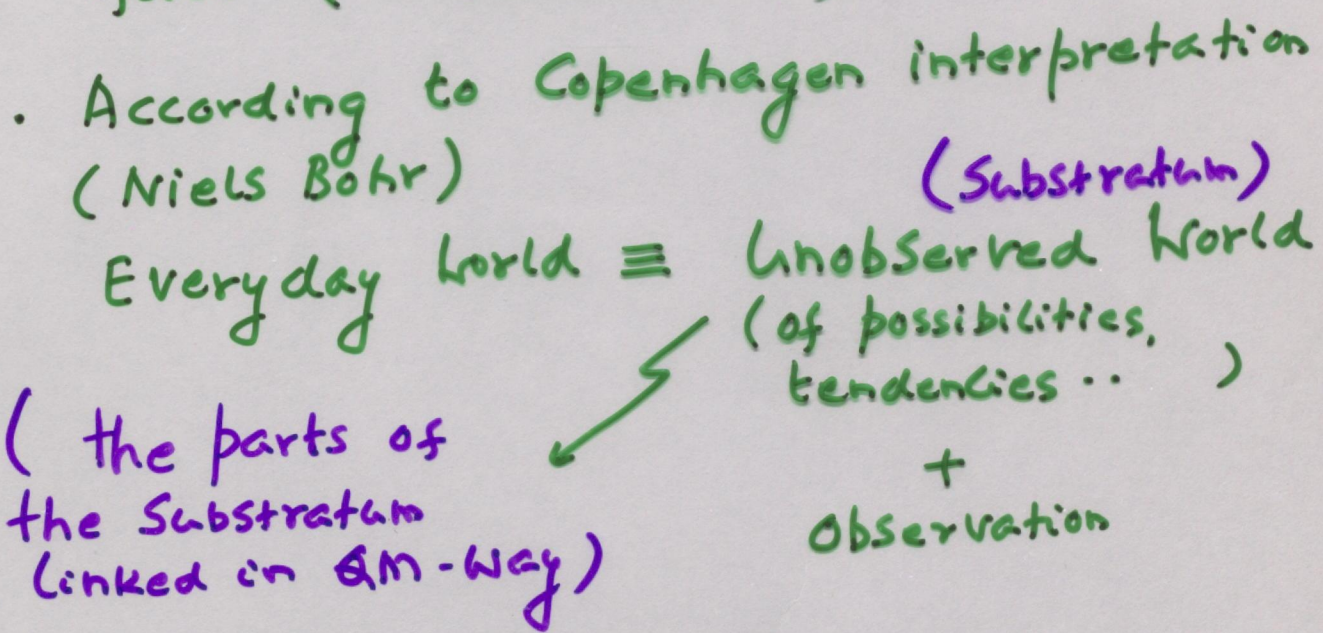
• The Hydrogen Atom - Lamb Shift
polarization of vacuum.

• Various types of forces - Exchange
of Bosons - photons, W^{\pm} , Gluons

• Virtual Particles.

Quantum Mechanics, Consciousness and Reality:

- Classical physics cannot make a universe that would last more than a billionth of a second - in the Big Bang Theory
- Quantum Mechanics does not make a real universe at all - without some outside help from non-material force (Consciousness?)



- According to Everett's many worlds interpretation:
Human experience is part of a larger experience enjoyed by similar beings - our other selves in similar universes

- * The focus on Quantum Mechanical vacuum, virtual particles - exchange phenomena - four dimensional Space-time Continuum
- * The "Flashback" universe - the Big Bang - the creation of all the ingredients and recipes for cooking the universe - the "anthropic" principle
- * Most important - Creation of the four dimensional Space-time Continuum with all the requisite properties "Spontaneous Fluctuations" within the limits of Heisenberg's uncertainty principle
- * Role of Co-operative phenomena - Coherence
Downward Causation
- * Structures at different levels and interactions between them - responsible



→ for all physical, chemical, medical, medicinal, engineering properties. The structures and the interactions are all manifestations of quantum mechanical vacuum

* The neuroscientists' approach to consciousness - nothing but "firing" of clusters of neurons. The neurons are chemical structures and the firing = "physico-chemical" processes.

'Consciousness' - yet another type of manifestation of QMv? Another emergent property?

* Bottom Line From Physics; not Philosophy.

Vacuum as the universal substratum is the key to all locks of the universe

* Parallelism with ancient insights!
(another lecture in another venue)

The World Space Week

objectives :

- ① Increase awareness of the Society about the benefits of Space Science and Technology
- ② and recognise the contributions that Space Science and Technology can make to the betterment of human conditions.

The emphasis is rightly on benefits and betterment

In this context we have to consider

- Physical - Material benefits
 - Psychological
 - Social
 - Technical
 - Educational
 - Knowledge
 - Remote Sensing
 - Meteorology
 - Defence
 - Communications
- These are interdependent and Space Science and Technology has contributed in all these aspects. We continue to do so.

Astronomy SCOPE And CONNECTIONS

ANCIENT
Astronomies

Positional
Astronomy

Astrometry

Egypt, Greece,
Mesopotamia,
China, India

Vedanga Jyotisha
1200-600 BC

Aryabhata

Brahmagupta

Varaha Mihira

Jay Singh

21st. Century

SETI - Search For Extra-
Terrestrial Intelligence.

Dark Matter

Exotic Matter

Superluminal particles
(not tachyons)

Neutrino Astronomy.
(Very High Energy)

Current Astronomies

Optical, Infrared, Ultra violet

Radio, X-ray, γ -ray, TeV, PeV, EeV,
Cosmic Rays, Neutrinos (Solar)

Types of objects

Planets, Comets, Asteroids, Meteors,

Stars, Clusters, Galaxies, Clusters of galaxies

Surprises

Quasars, X-ray sources, Pulsars

Neutron Stars, Black Holes

Organic Molecules

3° Microwave Radiation (Universal)

Expanding Universe. Accelerating Universe

Technologies :

- Large Mirrors, (upto 10m dia)
- Radio Telescopes
- IR, UV, X-ray, γ -ray detectors
- Cryogenics
- Large arrays - Scintillators, Ceramior, ...
- Balloon, Rocket, Satellites
- Computers, Electronics, Telemetry, TeleCommand.
- Monte Carlo Simulation Techniques.

Locations :

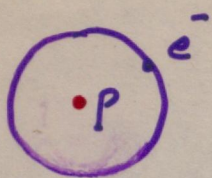
Sea Level, Mountain Tops

Balloon, Rocket, Satellites

Underground, Underwater, Under Ice

Strategies :

Simultaneous multiband observations
(International Co-operation)



Hydrogen atom :

The Proton and the electron are held together by the exchange of virtual photons. All the action is in the vacuum in between.

Pagels : "Nothingness contains all beings. All of physics ... everything we hope to know is waiting to be discovered in the vacuum."

Weinberg : "However for some time now we have been receiving intimation that beneath the level of elementary particles of physics there is a deeper level - call it if you like the Substratum and its inhabitants are probably best described not in terms of particles, but in terms of fields."

- An important aspect of this Substratum is Spontaneous Fluctuation. - which can lead to creation of particles.

Puzzles of space, time, matter, radiation ... in fact everything are hidden in the vacuum.

BEYOND THE ATOM AND THE NUCLEUS

↓ World of Quarks and Gluons

Each Proton and Each Neutron is made of three quarks held together by the exchange of gluons.

The Nuclear forces are long distance residue of quark-quark forces, like van der Waals forces in chemistry.

Things $\xrightarrow{\text{Chemistry}}$ Compounds, elements, molecules

Heat \rightarrow Conduction, Convection, Radiation.
Motion of molecules - Thermodynamics and
Statistical Mechanics -

Light \rightarrow Colors, Reflection, Refraction, Polarization.
Corpuscular and wave theories. - EM theory of Maxwell

Electricity
Magnetism \rightarrow Faraday's Laws. ideas of Fields

Falling Bodies
Planetary Motions \rightarrow Gravitation - Newton's Law. -
Newtonian Dynamics.

Sound \rightarrow Waves of Compression and Rarefaction
Molecular Motion Theory.

Scene of all

~~All~~ phenomena - encountered in daily life -

falling bodies, day and night, planetary motions, ^{heat,} electricity, magnetism,
light, sound, Radio ~~and~~ TV - just experience in
terms of the concepts

mass, charge, particle, laws, motion, vibration, electric, magnetic
and gravitational fields

Consequences of mass, energy, momentum, angular momentum, charge. - Newton's Law.

Faraday's Law of induction.

Maxwell's EM theory.

Concepts of Field ~~parallel~~ laws a ~~same~~ nature - because it has
linked up with Action - then laws are, motion - they are laws
that it has. . . Super in the exper. sites at a ~~distance~~ -
did not help.

It led to - Michaelson-Morley - Expt - the ~~error~~ of their
charged many things.

3000 BC Charvaka Vedanga Jyotsha (<1400 BC)
800 BC Susruta

640-546 Thales of Miletus.

570- Pythagoras. Buddha
Lao Tzu, Confucius.
Parmenides

(470-400) Democritus Heraclitus.

(469-399 BC) Socrates

Plato

(429-347) Aristotle

(384-322) Epicurus

340

600 BC

700-300 BC

300 BC

600-500 BC

Shankara 788-820 AD.

Ramaja 1017-1137

Madhva. 1199-1278

Lohajit - Charvaka
Nyaya - Vaishnava
Sankhya

BC

AD

400-700 AD. #

Angabhata.
Vachaspathi
Brahmagupta.
Bhaskara

Hobbes 1588-1679

Descartes 1596-1650

Leibnitz 1646-1716

Spinoza 1632-1677

Locke 1632-1704

Kant 1724-1804

Berkeley 1685-1753

Hume 1711-1776

Kant 1724-1804

