

2014



NATIONAL INSTITUTE OF ADVANCED STUDIES

Indian Institute of Science Campus,
Bangalore - 560 012, India

Modern State

and

Beyond

B. V. Subbanyappa's Manuscript

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Modern Science and Beyond

A Historical Introduction

Preface.

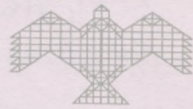
Acknowledgments

1. Man in the Universe - An overview
2. Pre-Modern Science: A Perspective
3. Modern Science: Its origin and growth
4. Characteristics and Limits of Modern Science
5. Values, Science and Religion
6. Humanism and Science
7. Science and Jewish Religion - A Historical Survey
8. Globalization and Tradition in Jewish Context

Supplementary Notes

Bibliography.

Preface



History of human progress —
followers — Archaeological inscriptions
Cetany Souda.

{ History of Science — No freedom.
Astronomical knowledge.
Mathematical knowledge — medicine — history
Babylonian, Egyptian, Indian, Chinese, Greek
Greek, Roman, Islamic.
Similar manner.

Records impressive — in order in Sanskrit
Mutual influence, exchange

* Nature and pathway of transmission of
8th - 12th Century CE

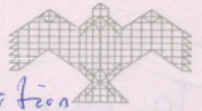
Emergence of Persian 7th Century — Caliph of Baghdad.

Arabic had become the language of Science.
Wang of Plato, Hippocrates, Aristotle, Euclid
Problems — of Hellenistic schools of Alexandria
Greece — Roman medical thinkers — Hellenistic School
of Alexandria, Astronomy, medicine, mathematics in
Sanskrit for India

Translated to Arabic.

Baghdad and Cordova in Spain —

Aristotle's ideas were known in Arab world



Aristotle's Concept of matter and motion
 India had evolved its mathematical astronomy

- Trigonometric and Computational excellence
 Surya Siddhanta, Sankhya, Nyaya-Vaisheshika -
 all dealt with motion and matter

No explanation for freely falling bodies
 even by Aristotle. (Heaven uses $\frac{1}{2}gt^2 - A$)

Renaissance Period - Letters and Arts in
 Southern Europe

Concept of Propetus for motion - Momentum

The Maragha School - accurate observations of
 Planetary motion - both circular, linear motion?

12th Century

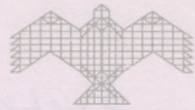
John Shabir of Syria - innovation in
 Ptolemaic Sun's retained geocentric idea
 Copernicus - Heliocentric.

Later half of 16th Century - Galileo - rejected
 Aristotelian ideas

Mathematical Explanations } by Newton
 + Gravitation

[India, Islamic Area contribute
 in the Renaissance period
 that give impetus

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To what extent is Modern Science
Europe Centric?

Have the Indian, Islamic and Chinese Contributions
Ignored which cannot be done in the
Case of Arts,

The Scope of the book outlined

Man in the Universe Our limits

13.7 billions - from before 50,000

Years ago "

Evolution of life forms

Cro-Magnon - Homo Sapien

Neanderthal man - discovered in Neanderthal in Germany

Stone age period 45000 - 1,50000 years

No evidence of remains of man before the age
Used Stone tools

Hempden - Metallurgical Science today concerned

1000 BCE in Europe - ^{Greek and} ^{holistic approach}

" Higher order in Nature than can be the Science
Methodical

Greek Ideas: different from Vedic Ideas

Relation between Human Man and Universe

Pinto Pythagoras, Socrates - Methodical

from an Aristotle

Aristotle is Plato's pupil



Ether the 5th element

Baghdad - Arabic scholars

New ideas - Post Renaissance 13th - 15th Century

Galileo - Refute

18th - 19th Century - Astronomy did not obtain been
like paper, charts and display

Controversy - Early part of 20th

{ correction - gases, leptons at electron -
quarks, leptons, neutrons

Hydrogen can not survive after - open

The universe does not is closed

But in extreme area - etc of the particles

Entropy does increase

Purpose of universe ?

Antropos Principle

is so facts - ipso facto

Time Space-Time ideas -

P.T.O

SEC 2

Section 2

Pre-Modern Science page 27 over



• early times to Renaissance

Mesopotamia - tracking of Solar System
Central and lower Mesopotamia 7th BC

domestication of animals

informat. available only after 1500 BC.

early Civilizations - Egypt, Mesopotamia, India

Mesopotamia) (China

(Babylonia) } Home of Scientific ideas

for centuries.

germs of technology - fire, bronze.

14th - 16th CE - foundation of Science.

Man - Spirit - Cosmos vision

holistic view of outer and inner.

China and SA Mexico - Incas

knowledge of Celestial Bodies - Astronomy.

Calendars - Mathematics, Number Systems
healing medicines, Studies of plants

Astronomical observations in Babylonia
3000 BC



Sylhet Division of time

Path of the Sun in 12 divisions

Babylonian - Chinese - Emerald Box

Periodicity of astronomical cycles

Egyptian Astronomy - not as correct as B.

Astronomical observation of pyramids

Egyptian calendar and geography.

More knowledge in Mesopotamia than B.

Embedding of dead bodies - astronomical knowledge. Thus lost being Sumer.

India

Indus Valley - 2750 - 1900 B.C.

1900 - 1600 later S.K.

Mohenjo-daro
Harappa

1.3 million sq. km.

* Came to light only in 1920-24

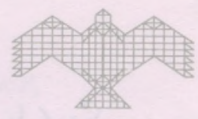
John Marshall, Archaeology Dept., Govt.
Terracotta

Script found on various symbols

Not deciphered yet

Under the name of Harappa

Vedic Times - 1500-700 BC.



Brahmanas and Upanishads
(Mantras) (Philosophy)

Uttireksha - an ordinal hole on dot
Caption - etc

* Concept of Visva-Jyoti - Unmanifested
Cosmic Light - energetic ensemble

Manifested and Colored Light - Stars, Sun, Moon
etc - manifest of cosmic energy

Rgveda - Red is ONE }
Nasadiya Sukta }

* Five Elements

Panchabhuta Concept - Earth, Water, Tejas
Vayu, Akasha

Starker Math Physics → physics
entire (Ubiquitous)

Chindas - also five elements

Indras
Prithvi - Nose
Ap - tongue
Tejas - eye, vision
Vayu - element
Akasha - Ubiquitous - everywhere

The four elements in the stars Sun
Mercury.



Provided data - by the elements - transcribed.

Provided concepts same for Agribusiness
Components of five elements - inputs.

Panchakshara Kalpa inputs for Samkhyas
Nyaya, Vaisheshika, Bhar & a limited
extent of Jaina, Budhism.

* Vedic Astronomy and Mathematics. (page 34)

Sacrifices to be performed at the
proper time

Moon became the obvious choice
for reckoning time (Masakkt)

Vedantic system - 5 year cycle (Yuga)

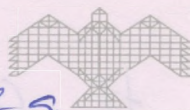
{ 27 Nakshatras. - Bharani
in Vedic Text - Mathematics.

Beginning of sidereal days.

Early Mathematics - { Sulbas - Sulbas
Squares and triangles

Pythagoras theorem known to
Vedic Astronomers

Sulbasutra " The diagonal of a
rectangle passes by it's both the
area produced by the separately by
it's sides "



Sulbasutra - Square of circles, irrational
numbers.

Pascal's triangle - in 16th century.

Aryabhata - 6th Century - mathematician
astronomer.

Siddhanta, Bhaskaracharya

* (Detailed details about India Math)

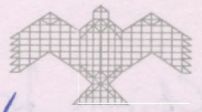
• Roots of Ayurveda

* Chinese Ideas: Chinese Thought structure
is not as old as the earlier Mesopotamian,
Egyptian or Vedic cultures.

God does not figure in Chinese Thought

Confucianism disdains all forms of
superstition - Concentration on human
life came as obstacle to progress
of state.

Taoism - opponent of Confucianism →



Meditated upon what came to be known as Tao of Nature. They took experiments to in areas like Alchemy, Medical Chemistry

But along side they have esoteric in the ^{of} millions of ancient _{millions}

Shaman and magical practices.

→ Objective approach to the study of nature eluded them

* Still Taoists believed in the unity of Nature and indefinite eternity

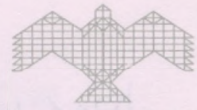
Study of five elements, Yin-Yang practices (Water, Fire, Wood, Metal and Earth)

Air was not one of them

Element - Earthly Relationship

* Yin-Yang theory →
two fundamental forces that constituted the universe
Yin = Darker (Female)
Yang = Lighter (Male)

Chinamen had developed Astronomy.



• Chinese Ideas -

Principle of Syllabic Organization Li

Chi = Conflict of matter and energy

Li and Chi inseparable

Chinese ideas did not play a role during Renaissance.

Greek Ideas

History of Science Starts with Greece

(No God, No Supernatural force)

Ionians (Yanana) - Asia Minor

Asiatic Greece in the Coastal region

(island) of Asia Minor

Eastward - Mesopotamia Greece

Westward - Egypt

Ionian traders reached as far as India

Greek Science ; (i) Pre-Socratic - Socratic
600 - 400 BCE

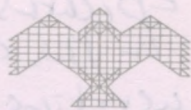
(ii) 4th. Century. Plato and Aristotle

(iii) Hellenistic period (300 - 100) BCE
Alexander the Great

(iv) Greco-Roman 100 - 500 CE

decadent period of Greek Science

• Ionians



Thales of Miletus (624 - 545 BCE)
predicted Solar Eclipse in 585 BCE

Thales - Anaximander Anaximenes,
Heraclitus Leucippus, ~~Pythagoras~~
Pythagoras (c. 582 BC)

Each figure about the universe in a
different way, but no overarching divinity

Matter + motion

four elements - Earth, Air, Fire, Water,
alchemy - transmutation

Leucippus + Heraclitus → Atomist Doctrine
of matter

Democritus (Contemporary of Socrates)

He "All things have been made of solid
concrete atoms together with
space or void between them"

* He emphasized that the void had
as much claim to be primary as
as the atoms themselves

(themselves)

Epicurus (342-270 BC) of Samos celebrated
in the Campus of Athens.



Lucretius (95-45 BC) - a Roman

and Epicurean - origin of the tree
an instance of stem

Even mental pleasure - stimulus.

" Greek Atomism remained dormant for
1500 years till resurrected by
Gassendi Gassendi in France Robert
Boyle and Newton in England in the
17th Century

Lucretius Magn. of Epicurus. Plank - Atoms
for law & higher forms.

Pythagoras distinguished Ionian -

Basic Principle of Math.

Numbers as basic elements.

Pythagorean Theory.

Either as the 5th element.

5th Century BC - Shift to Athens

Medicinal Ideas:



Hippocrates of Cos (430 BC)

transformed the Religion and superstitions
medical practices into a rational system
cause of disease to be found first.

* altered the center of medicine.

Setback due to Socrates (5th Cent BC)

No ridiculed emerging scientific method.

• Depressed new thinking about physical
universe

Socrates - deifying Centaur and Ethos

Plato - Aristotle

Plato (427-347) BC

Plato - all concerned on Ethos -

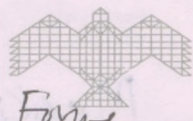
passionate about mathematics -
especially geometric forms

⇒ universe - a living organism with body
(cosmos) and Soul.

Doctrine: { Only in idea matter separated
of form and soul.

Reality = Forms - Geometric forms

Thales — Reality of Matter
Plato and Pythagoras — Reality of Forms



Aristotle: Most outstanding disciple of Plato
influenced Western thinking for 1500 years.

Speculative in Content.

Many of his ideas had to be demolished
to bring in Authority of Science,
exponent of inductive method, opposed to Aristotle.

Alexandria

Alexander was a pupil of Aristotle.

Astronomy, geography, —

Aristarchus — Contemporary of Archimedes —
Solar Center system before Copernicus

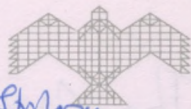
Euclid — geometry
light travels in straight line.

Archimedes — relative densities
levers, pulley, hydraulic screw

new trend in the technical thinking
of that time

Ptolemy's ideas —

Decline of Alexandria



Alexandria - Alchemy and Astrology
bizarre practices

Ptolemy advocated astrology

* Around 4th Century the intellectual climate
in the West started deteriorating
People of Christianity developed distaste
for investigating the physical world -
lead given by St. Augustine.

"Go out of doors. Return to
thyself. In the inner man dwells
truth"

Theology began to receive special attention

Europe groped in dark 400-1000 CE
Mysticism was taking its roots.

* In 415 AD Hypatia the only
woman mathematician of antiquity who
shed ^{fresh} light on algebra of Diophantus
and who had her own school
was murdered by Christian
fanatics.

The Orient Indian and Islamic Area



The future at this stage for Science was not in the West, but in the East
Byzantine Persian Empire and India.

4th-10th Century - India witnessed

"intellectual effervescence" in
Literature, philosophy, astronomy, mathematics,
medicine and metallurgy.

The Siddhantic Astronomy - 1st observations
and Computations.

Aryabhata I (c. 473 AD), Brahmagupta (7th)

Bhaskara II (11th), Lalla (8th) ...

decimal place value

Indeterminate equations - Sulerka

(Charaka (2nd), Susruta (4th)

Ayurved
text) Madhava (13th), Varahamihira (6th)

Islam emerged in the 7th Century
"Go out in search of knowledge"

Opposite of Christianity



Islamic Savants played a Savant
Role in imparting Role in encouraging
Scientific pursuits.

Arabic became the language of Science
All important texts in other languages translated
into Arabic.

"House of Wisdom" in Baghdad.

Nestorian Christian Ibn Ishraq (809-877)
was the noted leader of the translation
movement.

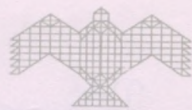
PSC

Hindu Numerals and decimal
place values - after learning
Sanskrit - translated to Arabic.

India gives the first place in Scientific
Advancement - compared to Greek, Roman and
Persian - show today in Delhi

10th Century } Islamic Savant question
12th " } Ptolemy's tables
Greek perspective

replaced by Copernic planetary system



* Spanish Muslim of 12th. Century

Averroes or Ibn Rushd :

He did not believe in single Creation.

But a Prime Mover who has
continuously producing it - if that's what
Cass.

Maragha

The Maragha School

Maragha built in Iraklu Part
of Persia (1259) → Ulugh observatory
at Samarkand (15th. Century)

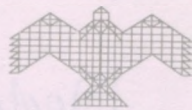
Jai Singh observatory in 17th Century.

* Maragha School influenced Copernicus
later

Copernican model identical to that
of Ibn Shatir of Maragha School

* In India the Kerala Astronomer Nilakantha
had developed a planetary model
around 1500 - Outer and inner planets
Jovial and the Sun, and the
Sun along with the Moon and the
Earth.

New Alchemy



Intellectual Revolution in Europe
by translating Arabic Science text
to Latin of 13th - 14th Century

Names like Alcohol, alkali, alcohol
Antimony, Zircon, alcohol, aldehydes
alair, 'Bebelje' Bebelje, Vege
Nedir, Zerk, Azimut, theodolite
theodolite, almanac - 'Kan Jitand

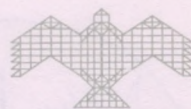
India number - Senya, jya, ko-jya
below zero, sine, cosine

Early European chemistry began with
Joseph Black, Henry Cavendish,
Karl Wilhelm Scheele, John Priestly Pristely
and Lavoisier - Discovery of oxygen
and other elements

Number System and Numerals

(Vedic Texts) of different periods

Modern Science



(p65) 12th - 16th Century Arabi → Latin
Translation Latin → Arabic

* Revival of Scholasticism in Univ
Thought of Aristotle Renewed pattern
of Univ → to Renaissance.

* Matter and Motion - New Insights

Matter = body.

How did a projectile continue its motion?

Motion of falling bodies?

Aristotle's long idea

French Thinker Jean Buridan
- Impetus theory for continued motion
did not explain falling bodies

Celestial Motion - Copernicus

Ptolemy's 80 spheres - somewhat intricate

(1543) De Revolutionibus - Copernicus



o Persistence - question regarding the motion of the Earth itself
If the Earth rotated its parts would fly away. -

Tycho Brahe's observation - Kepler

* GALILEON REVOLUTION

Galileo: (1564-1642) Pioneer of
mind of a genius

Mechanics

Learning Town of Pisa (expt)

Why did a falling body travelled
faster and faster as it fell -

(No ketch or clock)
denied later clock.

1604 -

1609 - Telescope

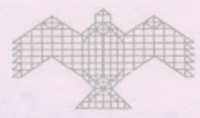
Kepler (1571-1630) - Laws

Aristotelian Astronomy lead to heart

Kepler - Platonic Ideas -

Solid Body of equal sides
and angles

p 76 1642-1727 \pm 125 yrs?



• Newton (1602-1727)

Magnam Opus { Philosophiæ
Naturalis Principia
1678

Determinism - Given Label

" Bay on the Seaside -

Matter or Form (debate fr. Plato's time)

Form = Actuality How best?

Form can change but not mass
esoter

Newton - alchemy - theory.

(p 77)

• Rene Descartes and Francis Bacon

(France)

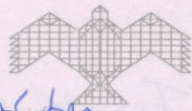
✓ (1596-1650)

(England)

(~~1506~~-1626) ✗

(121 yrs?)
1561-1626

Bacon emphasized on
inductive mechanical steps
to be pursued with vigor



Descartes laid down the principles
of Scientific methodology - omit nothing
pathway to truth

Mind & Consciousness
Cartesian duality - Mind / Matter.

He believed in the Creation of the Universe
by God. ∞ is infinite

Bacon: Rang the Bells that Called "Kiffs together"

Locke Japped the atoms hypothesis -
minute parts as the source of all qualities.

Heat and Light:

imponderable - weightless substance

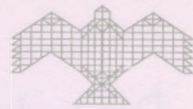
18th Century beginning \rightarrow "fluid" Caloric
(Squeezed)

heat - Caloric bond be squeezed out

1592 - Galileo - Thermoscope form of
thermometer

1701 - Newton \rightarrow air thermometer

1715 - Mercury Thermometer by Fahrenheit



Joseph Black in 1728-29

Latent heat idea.

1830's Conservation of Energy
Convertibility of one form to
another

80

Light Newton's Corpuscular theory }
(1690) Huygen's wave theory }

explained Refraction

Young's double slit experiment - interference.

Velocity of light problem - in a medium

Fizeau, Foucault - $300,000 \text{ km/s}$

Magnetism and Electricity

William Gilbert (1546-1603)

Physician. Earth's magnetic

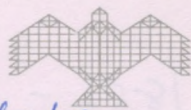
properties of loadstone

Electricity - Static Electricity known for a long time

Coulomb (1736-1806) - Torsion Balance

Volta (1745-1827) - passage of current

Current



Electro-Chemical Methods for Separation
of Elements - Humphry Davy (1778-1829)

Oersted (1777-1851)

Electric current deflected a flag needle
Arago } coil of wire with current
Biot & Savart } produced magnetic field

Michael Faraday (1791-1867)

Invented Dynamo.

Levi-Montalcini (1831-79) EM theory.

• Concept of Energy - Conservation

Chemical, Mechanical, Electrical, EM

Joule - Relation between work and heat

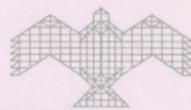
[Joule = ~~Amount~~ The amount of work
needed to raise one pound of water
by one degree Fahrenheit.

Living Force = Energy

" Living Force (vires viva)

Nothing is ever lost"

1852 - Lord Kelvin (Thomson)



Lavoisier - Law of Conservation of mass

Joule - " " " of Energy

PSS Chemical Synthesis

Alchemy, Metallurgy -

Ceramics, glass, dyes, pigments,
Cottons and Perfumery

Medical Chemistry -

(1493-1541)

Paracelsus - Mercury, Sulfur, Salt

inherent
ideas of

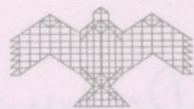
nature of
all metals

↓
power of
Combustion
Impurity
Change.

↓
fixity
resistance
to fire

Hellmuth - Classified into Liquid, Solid, gas
Acid, alkali, bases

Idea of Affinity



Cavendish (1731-1820)

Priestly (1733-1804)

Scheele (1742-1787)

} Study of gases

CO_2 , H_2 , Ammonia, Nitric acid

Hydrogen chloride, Chlorine, SO_2

properties studied in detail.

Lavoisier (1743-94) became a landmark. 23 elements recognized.

Berthollet (1748-1822)

(French) named as per Lavoisier's concept.

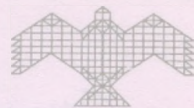
* Era of 18th Century Chemistry
attained the status of Science b/c
{ Ideas of elements showed affinity,
Law of Conservation of mass
Lavoisier - Founder of Chemistry.

Atomism

Proust Hypothesis (1755-1826)

Law of Definite Proportions \rightarrow always true

Dalton (1766 - 1844)



Air is composed of the same proportion of
oxygen, Nitrogen like sugar and
of CO_2 , Water vapour

Dalton - Different minute particles of
different size composed air

Avogadro hypothesis. (1811)

Berzelius (1779 - 1848)

Electro-chemical aspect

Meyer (1820 - 95)

Dmitri Mendeleev (1834 - 1907)

} Periodic
Table

enabled fore-telling of elements to be
discovered.

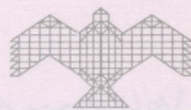
(89) Structure of the Universe

Paris Observatory (Louis XIV - Command)
(17th Century)

Charles II in England.

Greenwich Observatory
posited of 20,000 stars

Malay Comet first 1682,
75 1/2 yr. cycle.



Herschel - Nebulae.

Celestial Mechanics.

Study of Solar Spectrum (Wollaston)

Fraunhofer (1787-1826) attached
a telescope to a prism to examine
Solar Spectrum in detail.

Spectrum Analysis & Nature of Matter
(Kirchhoff (1824-87), Bunsen (1811-91))

Cesium and Rubidium discovered.

Doppler Shift

(p42)

Terrestrial Magnetism.

Earth; Shape of the earth

Terrestrial Magnetism Gauss (1777-1855)

Magnetic observations established
all over the world - also in India

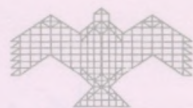
External and internal Structure of

the earth - Geology

Paleontology - Study of Fossils

Geological Survey - GB and India
(1851)

Volcanoes mineralogy
Concept of 'Gondwanaland' -
India - Australia together



Biological Discoveries 17-19th Century

Microscope became an important tool.

Microscopist - Marcello Malpighi (1628-94)

Robert Hooke (1635-1703) Bologna

Nehemiah Grew (1641-1712)

Van Leeuwenhoek (1632-73) Delft.

* Structure and behaviour of plants and animals

Microscopic demonstration of the channels of flow of blood confirmed the idea of Blood Circulation by Harvey (1578-1657)

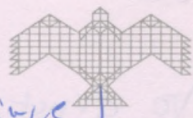
Secretion, fibrillation, of muscles

Classification of Plants. - Species - Genera

Early in 18th century - Mechanical
Concept of Life - debate

Chloroplast - in plants

multicellular organisms (Parkings)
1787 - 1869



Protoplasm

unicellular organism - Protozoa.

Ernst Haeckel (1834 - 1919)

Protoplasm = mixture of amino acids

Life - Chemico-physical phenomena

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Evolution

Philosophically Evolution = Being → Becoming.

Mid 19th Century - Charles Darwin (1809 - 82)

Evolution = Development.

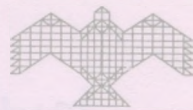
• Jean Baptiste Lamarck (1744 - 1829)

postulated NO Frontiers or Boundaries among the species now they have fixed and called ones.

Environment produces changes - puts pressures on organs. "Law of Use and Disuse"

Giraffe stretching its neck → larger neck in the species

No direct evidence for this.



Such developments had to be transmitted to the ~~offspring~~ offsprings or descendants.

Malthus (1766-1834) Essay on Population — Struggle for Existence

Darwin's Sea Voyage: on Beagle (1831-34) — various peculiarities of plants and animals.
Voyages
with Darwin

Alfred Russel Wallace (1823-1913)

geographical variation — biologically important

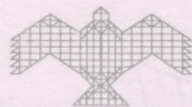
Living organisms on the ocean floor compared with surface organisms.

Darwin's Book

"Origin of Species by means of Natural Selection or of the Preservation of the Fittest Races in Struggle for Life" 1859

two decades of study and thinking

Wallace also had Huxley of
along their line. and had
sent his list to Darwin. for opinion.



- * Darwin endorsed ^{Wallace's} his list admitted
their priority and published preliminary
work of the origin of species
in 1858 under the name of both "
A rare gesture of academic integrity

According to Darwin

organs and instincts are slightly
variable and there is a struggle for
existence leading to the preservation
of each profitable deviation of the
number or instinct.

Profitable deviations are inherited.

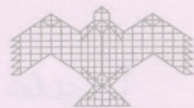
∴ it is Natural Selection than any specific
plan that has helped for new
species - this would serve as
progressive force. in which both
Law and Charles operate.

1871 Descent of Man.

opponents and opponents of Darwin's theory

Thomas Huxley Huxpaku

But the Controversy Continues - "Creationism"



99 New Experiments and Bold Ideas

Kirchoff - Spectral measures of Black Body
radiation - founder of Quantum theory.

Max Planck - Quantum hypothesis.
(1900)

($v \rightarrow \lambda$)

Mitchelson - Morley Exp.

If light is wave, what is vibrating?
role of ether. Einstein's theory.

X-ray (Roentgen (1845-1923))

Radiactivity Becquerel (1898)

JJ Thomson (1897)

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20th Century

$$E = hv \text{ not } E = mc^2$$

Bohr formulated the quantum mechanical

→ description of the atom in terms of

the paths, members in his theory and the class

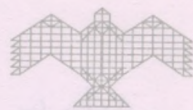


orbital, need in diff. quantized orbits.

For the motion of particles the classical Newtonian equation had to be replaced by the quantum mechanical equation of Schrodinger and Heisenberg the matrix formulation of Heisenberg. Bohr formulated the quantum mechanical theory of the atom by quantizing the orbital parameters

by adopting the Rutherford idea of the nucleus and the ^{Complex} Bohr orbits and Newton took the orbiting electrons and postulating quantized orbits for the electrons [Newton and de Meulan.]

Louis De Broglie wave/particle duality and Heisenberg's principle of uncertainty are kind of bagging aspects of QM [that came to be known today.]



Biology in the 20th Century

Genetics made great leaps.

Space Program

[A Series of Editors, Computers, Materials (plastics, Neos etc)
Should be put in before Space Tech
It is then difficult that made possible
advances in medical tech (Lasik, CT Scan, etc)
and in Communication - Satellite, Mobile phone,
e-mail, Internet etc -
We have entered the age of further
advances, ^{input} in further developments etc.]

P107 Literature of Modern Science

Physical World - a biological realm
could have as their mechanical domain

17th Century - Dynamic World
Scientific Discoveries

Royal Society } (1662)
Paris Academy } Exchange of Scientific ideas

Anthropocentric view \rightarrow Geocentric view
(Sun just one star.)

End of 17th Century \rightarrow end of Cosmology
of Ptolemy, Aristotle, Ptolemy.

Science begins a 'STATUERE'

AGE OLD IDEAS receded to the background
BUT Galileo, Kepler, Newton - inclined
towards THEOLOGY.

Kepler believed the world was
made in the image of God.

Newton - God as Creator.

René Descartes believed in God.

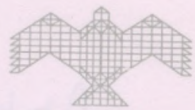
Bacon - God has written two books
"Scriptures and Creation"

Such an attitude did not cloud their Rationality.

Since the dawn of Science \rightarrow
Avoid prejudice, personal bias,
aim at objectivity.

Obscure vs Observed

Karl Popper



Theories could never be verified.

" Science by its present methods could ~~never~~ never claim that it had attained the truth, not even its probability"
Concept of falsification

External Character of Science

Industrial Revolution - middle of 18th & 19th Centuries

NETRO and Disunity of India.

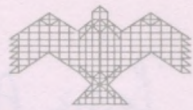
(P115) Science = Planning = Doing.

* International Character

Science is International - heritage of mankind
No boundaries (?)

Advanced Technologies not shared.
gap between Developed and Developing Countries because of this.

International cooperation essential



(117) Limitations of Science.

exploitation of Nature for human needs.
environmental degradation. - global warming.

(to understand Science and Tech. Areas
for Island for Nat. It is the Politician
that has to be trained)

* (Scientific knowledge through HUMAN SENSE
+ ALL THE EXTENDED INSTRUMENTS -
TELESCOPES, MICE, SCANNING, LASERS etc.)

What about input to knowledge from
Philosophy and Religion?

Observer - observed problem. Participatory know

Objectivity \neq Absolute Reality.

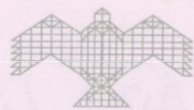
Concept of Relative Reality.

(118)

REALITY

Eddington - The stuff of the world is
Mind stuff.

Basic Assumption of Nash Scale is
UNIFORMITY OF NATURE



? Has not been able to provide an
acceptable explanation of the origin
of the universe but has accepted
the origin of Life.

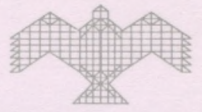
All explanations future so far.

Purpose of existence?

Ethics and Goals

Social Darwinism - Evolution Ethics

* The Enhancement aspect



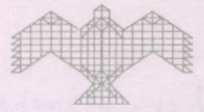
p124

(What happened in Germany in the 1930s

) First the Jews were -

persecuted in schools -

Overview of Man in the Western Side the
Steps for the Book



1 Contribution of each ancient culture
in the acquisition of knowledge

Each culture had its own approach to
astronomical ideas, mathematics,
physical ideas of the land, medicinal concepts

2 Extensive literature on these in Sanskrit
so also in other languages - Arabic, Latin

Arabic became language of science

3 & India evolved in mathematics

4 Renaissance - yearning for understanding
phenomena like motion - falling of
bodies - circular motion Aristotle, Ptolemy

5. 14th Century onwards - Galileo, Copernicus, Kepler
Why origin of science is Eurocentric?

6 India - Brahmi Numerals, decimal places

Value system

To know the development of Eurocentric is

an over simplification

7. History of Modern Science

Early Astronomy - Role of Copernicus, Newton



Beginnings of Science - Descartes, Bacon (Francis)
Heat and Light - Young theory.

Magnetism and Electricity - Gilbert

Benjamin Franklin Volta, Oersted

Ampere, Faraday, Maxwell - Description of individual contributions

Concept of Energy - Doctrine of Energy

Measurement - Joule

Chemical investigation - alchemy, metallurgy, glass, dyes

Medicinal Chemistry (Swiss)
(Mercury sulphur, Salts)

Cavendish (18th-19th cent) - Carbon dioxide

Hydrogen, Ammonia, Lavoisier - Hydrogen
ideas of phlogiston killed

Berthollet - Naming of Chemical

Boyle - Revived the Greek Atomic Hypothesis
(17th cent)

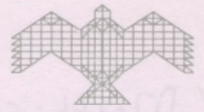
Proust (18th, 19th cent) - Law of definite proportions

Dalton's Atomic Hypothesis (early 19th)
(atoms of elements)

Berzelius - Electro-Chemical work

Mendeleev (20th cent - early 1834-1907)

Periodic Table



• Structure of the Universe

Paris Observatory - earlier 17th Century
Huygens -

Greenwich Observatory - (1676-1859) Charles II

Edmund Halley (1656-1742)

{ 1682 - Comet prediction
1705 - again

Kirchhoff and Bunsen - Spectroscopy of elements

Cesium and Rubidium - Doppler Shift (1803-53)
1st day.

• Terrestrial Investigation

Terrestrial Magnetism - Gauss the mathematician behind it

Studies of the earth - Concept of the Gondwana land

Biological investigation (17-19th)

Botany and Zoology - Microscope

Classification and Naming - botanical Latin

• Nature of Life - as mechanical explanation
(Early 18th C) possible?

Protoplasm is individual cells identified by

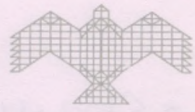
Purkinje • Cells are the basis of life

Claude Bernard - Body processes - Chemical,
physical phenomena

• Evolution Darwin (1809-1882)

Lamarck (1744-1829)

✓ Law of use and disuse



{ Malthus (1766-1834)

{ Essay on Population - Struggle for existence
to limit the population

Charles Lyell - influence of land masses
(Environment?) on distribution of living beings

{ Darwin's *History of Evolution*
H Wallace (1823-1913) } fairly detailed
Natural Selection and the } prediction of
Species form } their fossils
Survival of the fittest

Wallace - independent of inheritance of

End of 19th Century

New experiments - that changed physics

X-rays, radioactivity, electron

20th Century - Relativity - discovery of the nucleus
Genetics, Space technology

information theory - Globalization

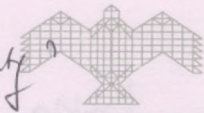
Cosmology - Big Bang - Expansion of universe
Intelligence through mind.

• Limitations of Science

Stages of development of Modern Science
from the Renaissance Period

Nature = Language of Mathematics

Experiments 16th Century



• Reality - What is the ultimate reality?

What is the basic stuff of the knowledge
ground? is it projection of our senses
or outside them?

Example - the stuff of the world is kinetic stuff

What is the Purpose of our existence?

Evolutionary Ethics - Spirit of altruism
Darwin's theory

The Influence of Science

Atom Bomb (Potsdam Conference)

• Values: 26th Century transcends the fate of
the world Capital & Labor happened in
5000 years ago

Achievements of Science - on the + side

gains knowledge through senses and the mind
Co-ordination the knowledge
most democratic approach

• Science ^{as} and transcends creativity -

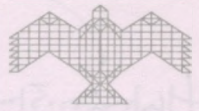
Recreation of the hidden secrets of nature

Verifiable facts - no bias - no authority can interfere

No finality no dogmatic assertions

Blind faith is required.

- Spirit of,
 free enquiry and Reasoning
 Value of Reasoning.



Science and Religion are products of the mind

Religion is a way of life - Hinduism, Buddhism

Can there be a dialogue between Science and Religion?
 Between Logic -

Environment

Science has its faith too - Uniformity
 Laws of nature

Motivation for Science - Truth and Understanding

Quote for Einstein

Science has been trying to find a unifying
 theoretical basis for all observed phenomena

E - God Reveals himself in harmony of all
 beings

Science & its logical ground? -

Spirituality - oneness

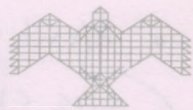
Man's life does not have any he is born
 to the earth? And purpose

The Universe continues to be mysterious
 but all the answers



Substance of all laws
for thought above

and



6. Humanism of Science

1. Can science be a source generating humanism?
2. Has science shown the seeds of dehumanization?

Humanism: One human being to share of another
as he thinks of himself

Science has been misused for the unstaying of
Omas

Human Sensibility is the key-factor for
protecting humanism

irresponsibility regarding environmental degradation
Collective devoted efforts, nationality and
internationality

- Education plays an important role to promote
altruism

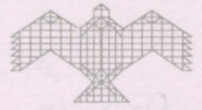
Has truth become slave of technology because of
excessive use and dependence

- Human Condition - They have deteriorated?

20th Century - harbinger of social terrorism, disease
and conflicts

Alvaria's 'Otha' tra

Life has its openness and freedom
material enticement



Since our Indian Religions - historical
India's past is also its present
God is immanent in the created - Brahman

Hinduism, Jainism, Buddhism medicine and natural
Vedic texts - astronomy, mathematics, ~~mechanics~~, biology -
metallurgy - physics as part of Rigveda
traditions

- Early Scientific Ideas -

four Vedas Vedic Gods had no physical form
Sun, Moon, clouds, rain, lightning, fire
and other natural phenomena extolled as Gods

Gradually idea of ONE God
Vedic Acharya - which is not capricious
but ordered one

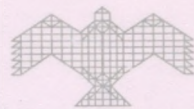
philosophical regions in changing

Study of nature of Sun and Moon

Sanskrit word - geometrical forms -
Sulvasutra

Worship of forms came much later.

Special Mathematics and Astronomy



Hindu numerals, decimal place system
Kerala mathematics - trigonometry from Sri
Aryabhata - Cosine and sine position
of planets

Eclipses - as bad omen.

Medicine - Ayurveda - Charaka, Susruta, Acharya
Kani and Mishra
(Dionysius) for Cancer etc

Colonial period - Western science introduced
Botany, Zoology, Geology, Agriculture, Surgery
by European scholars, engineers
flora, fauna, minerals, climate, culture and
geography studies

Review of traditional learning - Sanskrit, Arabic, Persian
Raja Ram Mohan Roy - Hindu College in Calcutta
(1823)

Universities - Kolkata, Bombay, Madras (1857)
Lahore, Dacca 1882, 1887

Social and Religious Reform Movements
'Hindu Society' and 'Vedha Samaj'

Bootho Samaj - 1828. Raja Ram Mohan Roy
Arya Samaj - Dayanand Saraswati
Upper & Higher Educat
Vivekanand - Ram Kher Dasgupta

Hindu Science

British Policy - Neutrality and Non interference in
religious matters

Many European sources believe Hinduism, Jainism, Buddhism
inspired given to Hindu Calcutta, astronomy
all Hindu Medicine

Madras Observatory established in 1752
synthetic account of the stars

P.C. Day - Hindu Chemistry

Dewan Chandra Shekhar for Edinburgh & Edinburgh
first pharmaceutical company in India

Ayurvedic Colleges - Ranchi,
Delhi

Sharda Pishore in Sule

Mahendra Lal Sircar - headed the
Sharda Pishore for the culture of Sule

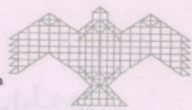
1876

C.V. Ramesh Rao's paper India - 1920

S.N. Bose, M.N. Saha

Praxis

1885 - Nehru Congress - Gandhi's home
Nehru



Nehru, Rajan and Ganes

se 8 } A Synergistic Scenario
Globalization and Tradition

Manifest Amphidromy of Time.

World is no longer isolated -

telecommunities, fast travel

Globalization has awakened consciousness, Latin grand
physical and psychological problems - the style of life

Double edged sword - enthusiasm of material life
faster pace of living
increasing anxiety stress

Indic Tradition

Astronomy, Astrology - interwoven

Agurveda - the traditional way - } all

Homoeopathy, Sushruta, Unani

Western medicine

all
connected

Religions and spiritual traditions not affected
by Globalization Yoga has become
international.

Supplementary text

