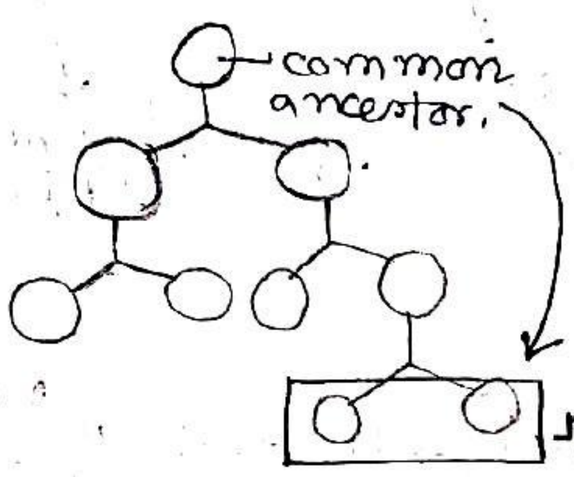
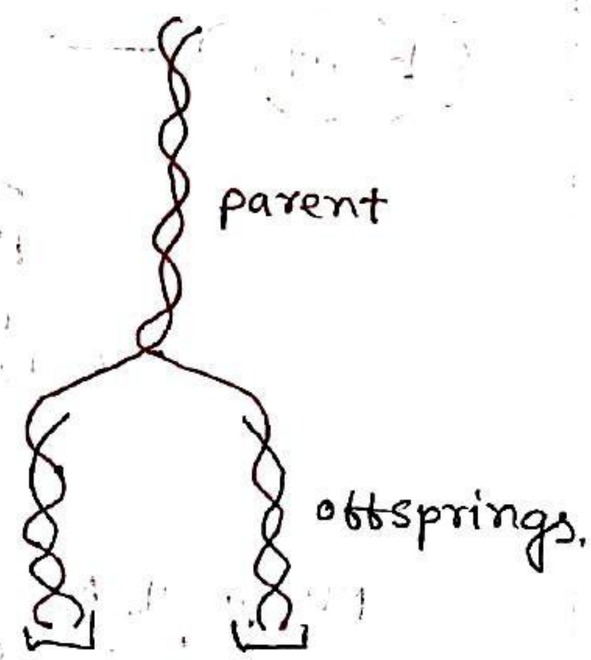
Evolution

Origin of Life

- Evolutionary Bidogy → Study of history of life forms on earth,
- Evolution :- To Understand the changes in flora and fauna that have occurred over millions of years on earth.
- According of Darwin → Descents with modification, (variation),
- Unit of Evolution → Population,
- Raw material of Evolution → Variation;





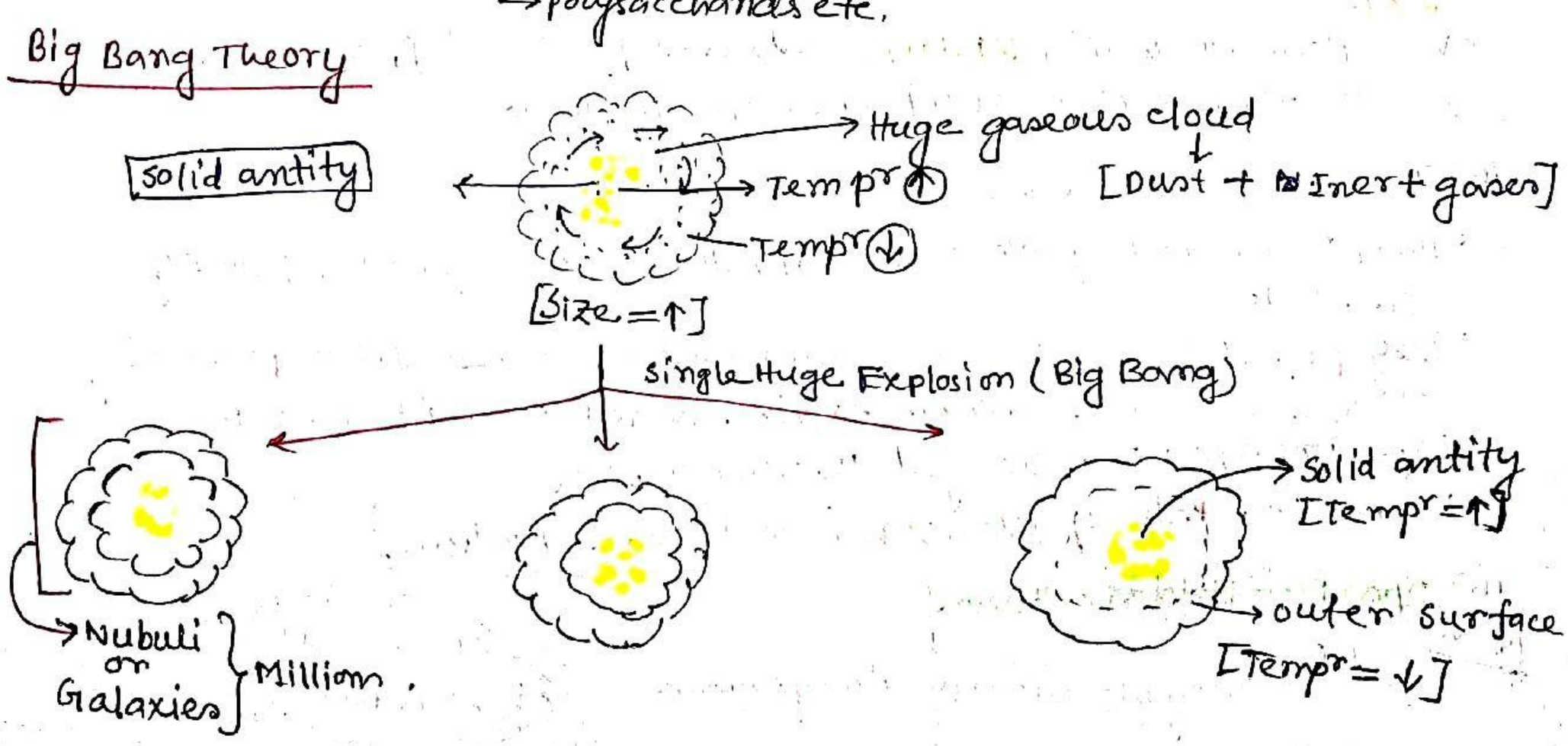
Origin of Universe :-

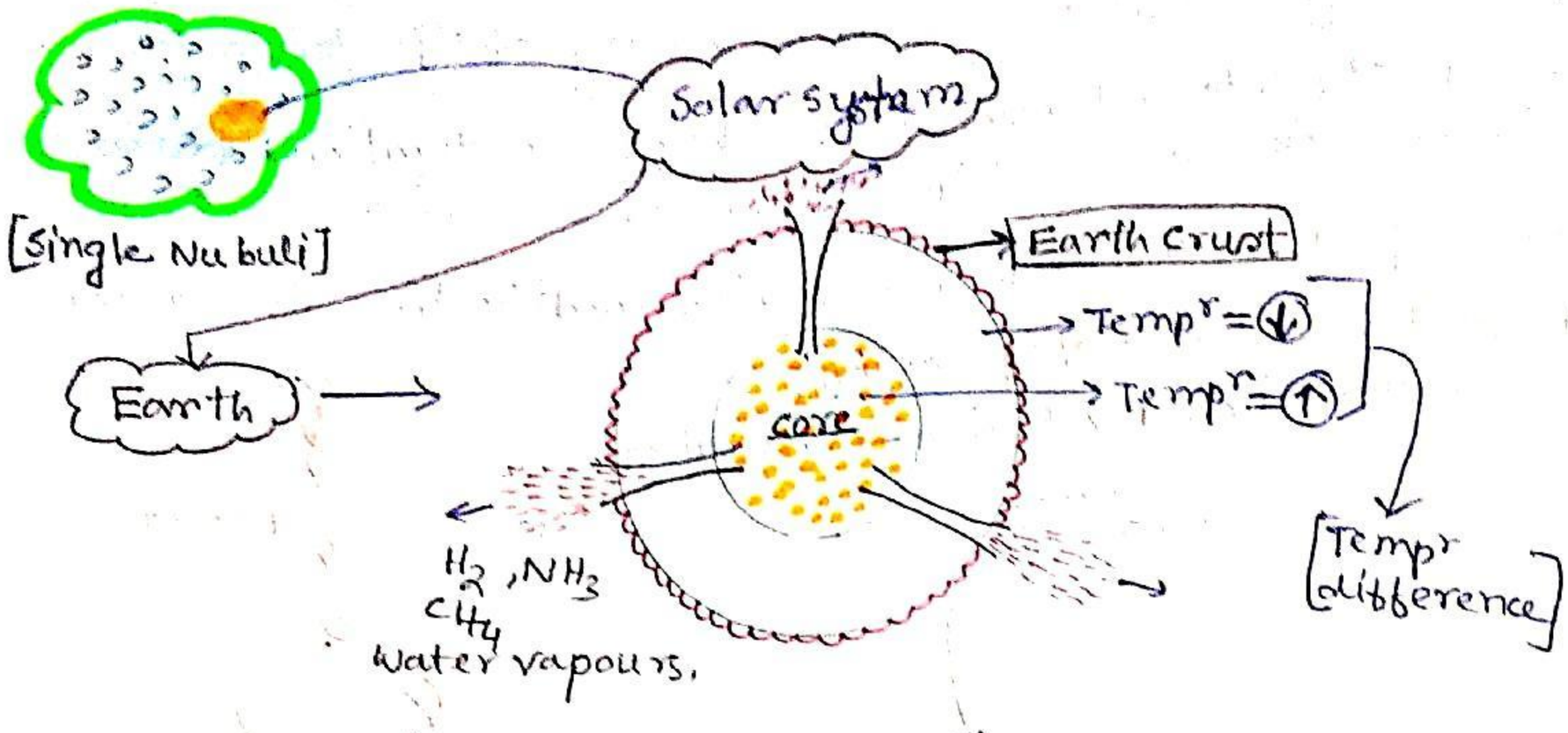
- When we look at stars on a clear night sky we are, in a way, looking back in time.
- Stellar distances are measured in light years. What we see today is an object whose emitted light started its journey millions of year back and from trillions of kilometres away and reaching our eyes now.
- However, when we see objects in our immediate surroundings we see them instantly and hence in the present time. Therefore, when we see stars, we apparently are peeping into the past

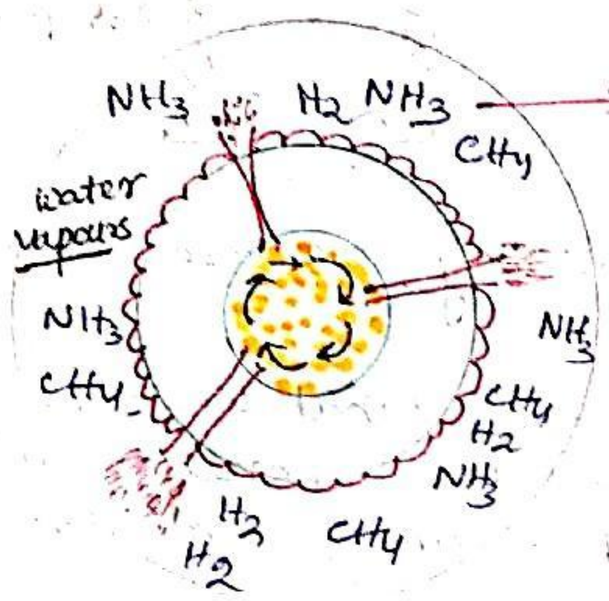
Origin of Universe → 20 B.Y.A (Big Band theory).
origin of Earth :- 4.5 B.Y.A.
origin of Life :- 4.0 B.Y.A (500 million years after formation of Earth)

- [Non-cellular] [3.0 B.Y.A] → Giant molecules → protein, RNA, polysaccharids etc.
- [cellular] [2.0 B.Y.A] → Unicellular → Multicellular.

Big Bang Theory







[Pre. mitive. atomic condition] → $NH_3 + CH_4 + H_2$ + water vapours } Reducing Condition.

[O_2 = — nt in free forms]

Theories to Explain origin of life:-

① Theory of Special creation.
② Theory of catastrophism.
③ **Theory of pamspermia/ cosmozoic Theory:-**

Some scientists believe that it came from outside. Early Greek thinkers thought units of life called spores. were transferred to different planets including earth. 'Panspermia' is still a favourite idea for some astronomers.

④ Theory of Spontaneous Generation ('Theory of abiogenesis):- (Aristotle and Von Helmont).

- According to this life arises spontaneously out of non-living matter.
- Von Helmont within 21 days rats are produced from wheat grains kept with a shirt drenched in sweat.

⑤ Theory of Biogenesis:-

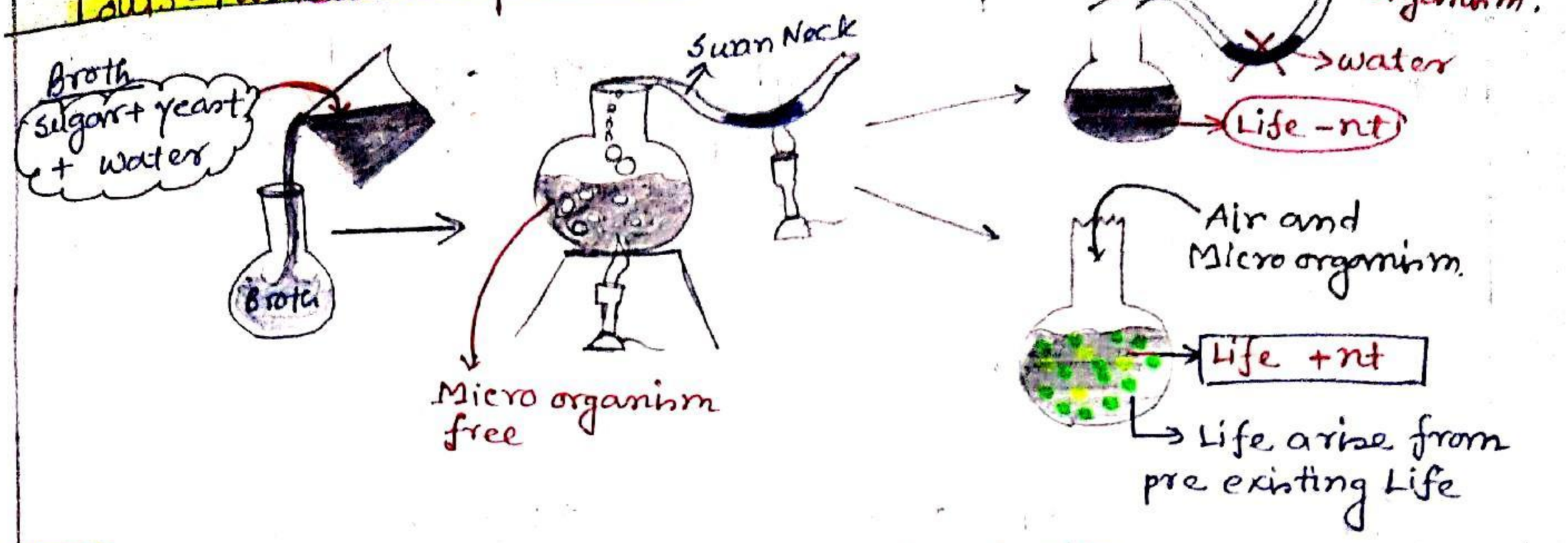
- The Theory of Spontaneous generation was disproved by many scientists.
- They proved that new organisms can be formed from preexisting ones, i.e., omnis vivum ex vivo. Noted scientists who experimentally callenged the theory were,
- Francesco Redi, Spallanzani and Louis Pasteur.

⑥ Oparin - Haldane Theory (V.V.I)

or

Theory of Primary Abiogenesis or Chemical Evolution.

Louis-Pasteur's Experiment



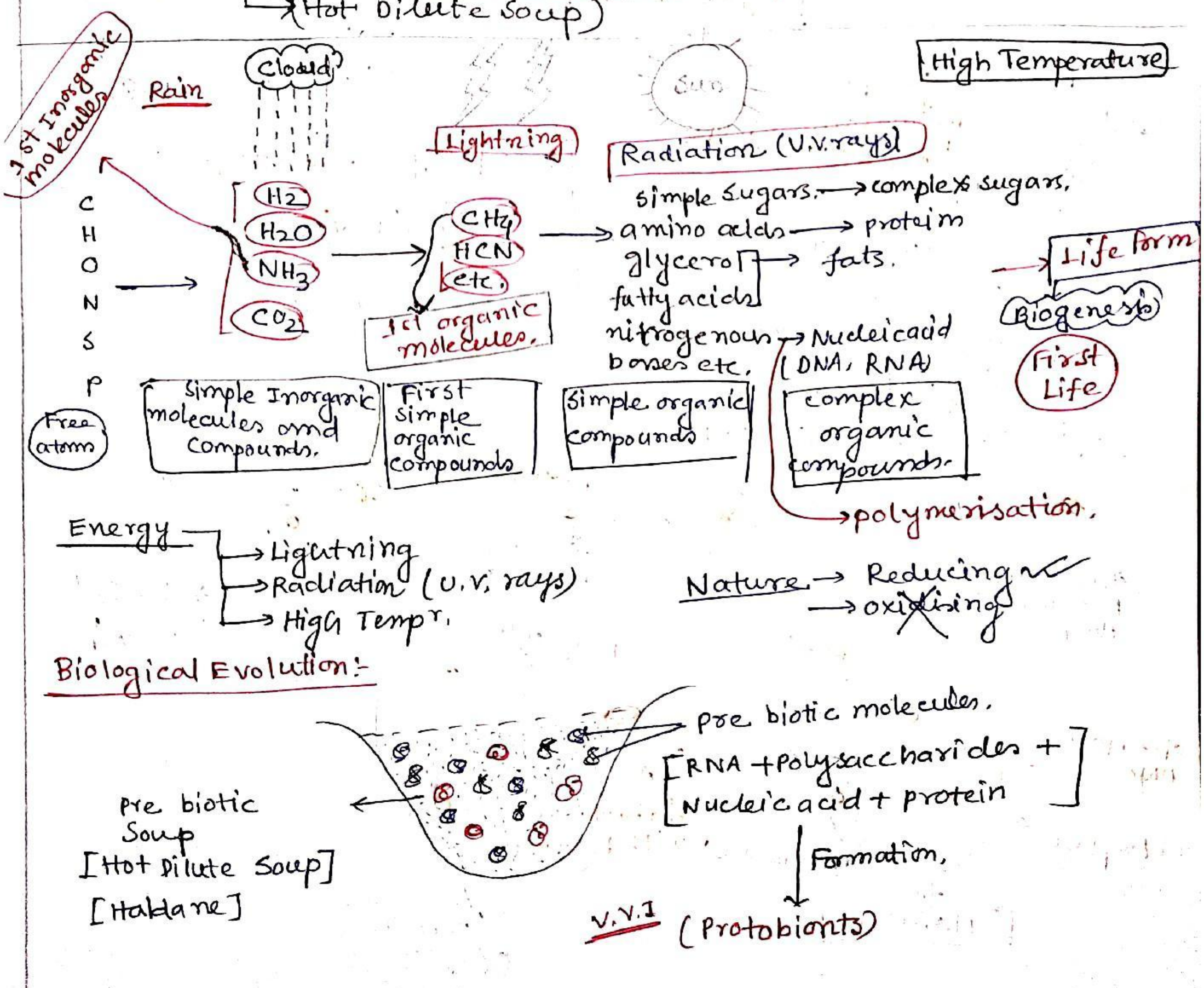
Lec 02

Oparin and Haldane's Theory of origin of Life

- The above mentioned simple molecules combined to form complex biomolecules in water in presence of following energy sources:-
  - Heat from volcanic eruption
  - Lightning from clouds.
  - UV rays and X-Rays → Radiation.

SEENCERT → Miller's Experiment

- ~~Hg~~ Life originated in water.
- Alexander I Oparin was a Russian biochemist.
- He wrote the book 'origin of Life'.
- J.B.S Haldane was an English physiologist who later on settled in India in Bubaries war. (Hot Dilute Soup)



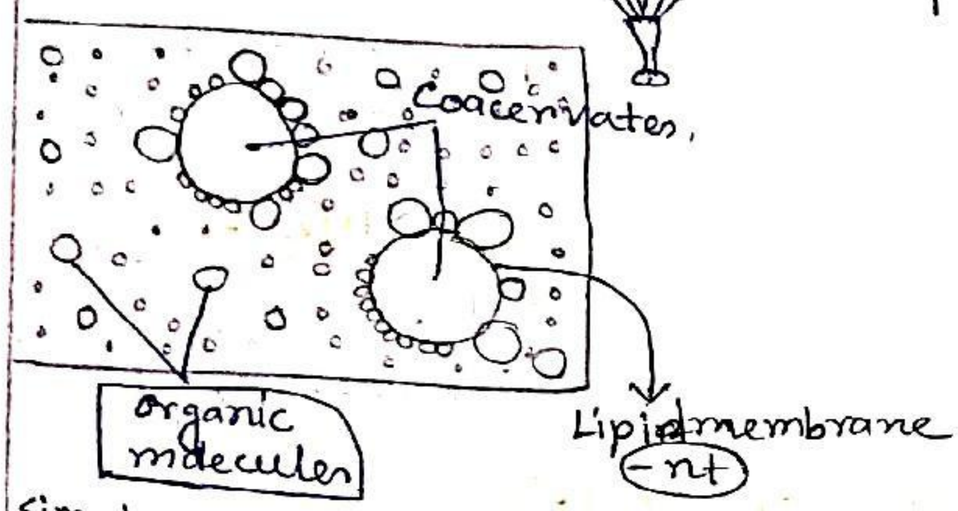
Biological Evolution:-

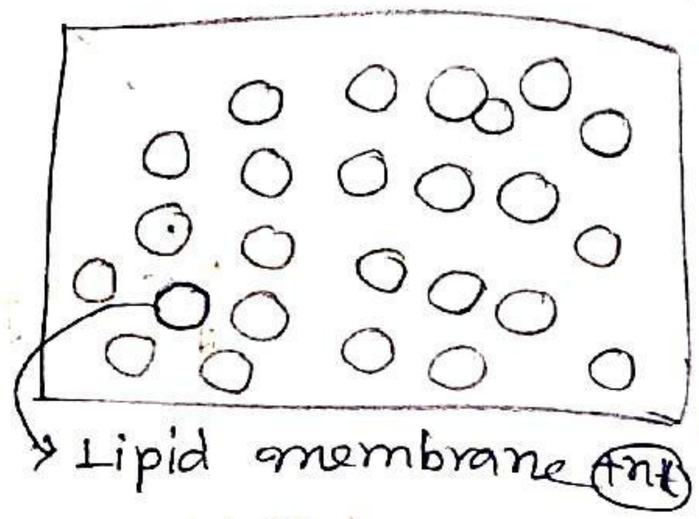
Pre biotic Soup
[Hot Dilute Soup]
[Haldane]

Pre biotic molecules.
[RNA + Polysaccharides + Nucleic acid + protein]
Formation,
V.V.I
(Protobionts)

Type of Protobionts

- Coacervates (Oparin) → Large protein + polysaccharides
- proteinoids + Lipid → Microspheres (Sydney Fox)





Simple types of Metabolism (+nt)

Protobionts → 1st – Non cellular Life (3B.Y.A) = Anaerobic condition.

[RNA + Protein + polysaccharides] → Prokaryotic cells → 1st – cellular Life (2B.Y.A)

① chemoheterotroph. (Anaerobic) → Formation of organic compound, Energy.

② chemoautotroph. (Anaerobic) eg → (Iron bacteria) → Chemical Reactions, Energy.

③ Simple – photoautotroph. Eg → (Sulphur Bacteria) [Anaerobic] → Formation of Pigment, Used Light Energy, Breakdown of H_2S

④ Photoautotroph:- Breakdown of H_2O Eg → (Cyanobacteria)

Light → pigments

$2H_2O \longrightarrow 2H + O_2\uparrow$ (Release in Atm)

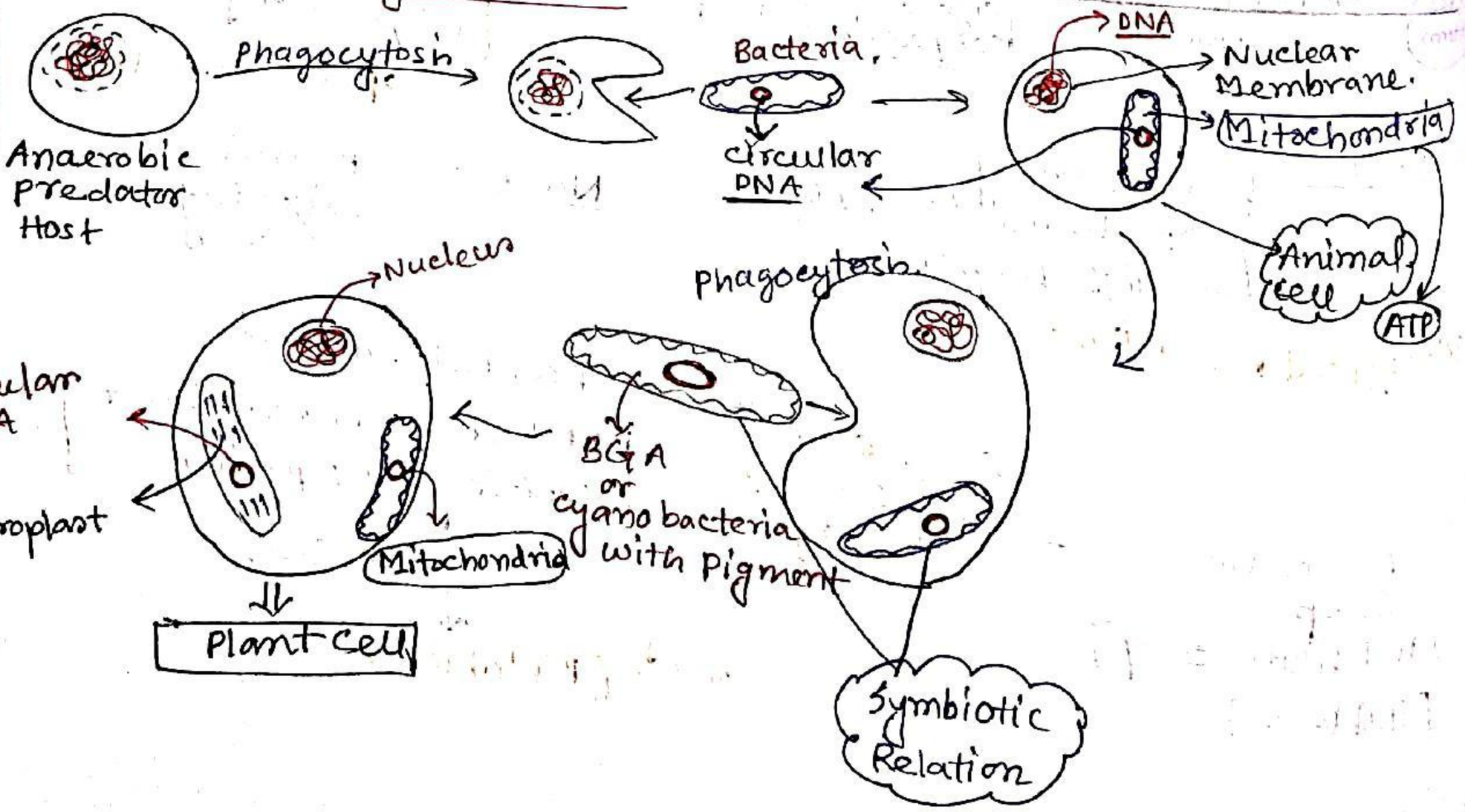
$O_2\uparrow$ Atm become Oxidising $O_2\uparrow$ (all sides)

$2O_2 + CH_4 \longrightarrow CO_2 + 2H_2O$

$3O_2 + 4NH_3 \longrightarrow 2N_2 + 6H_2O$

$2O_2 + O_2 \longrightarrow 2O_3\uparrow$ (ozone)

origin of Eukaryotic cell:-



Lec03

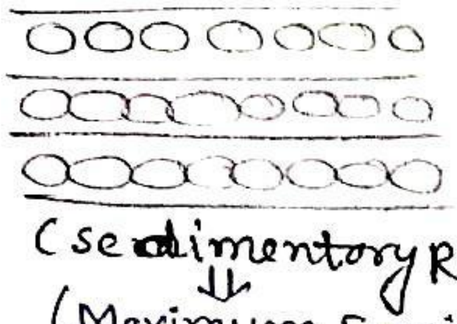
Evidence in favour of Evolution

1) Palaeontological Evidences (Evidences From Fossil Record)
2) Evidences from Comparative Anatomy and Morphology. (V. V. Imp
3) Embryological Evidences (Evidences from Embryology)
4) Evidences from Physiology and Biochemistry.

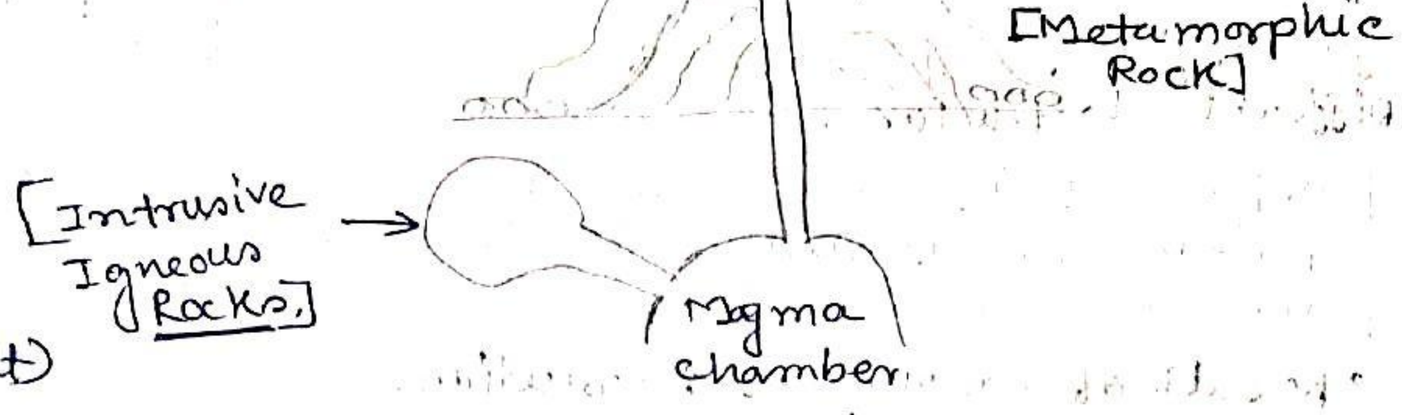
1) Palaeontological Evidences (Evidences from Fossil Record)

Fossils → Fossil can be defined as the remains or traces of the non-degraded parts of ancient living things found within rock life preserved in the Earth's crust.

NOTE → Palaeontology → Study of Fossils.



(Sedimentory Rocks)
(Maximum Fossils Pnt)



NOTE:-

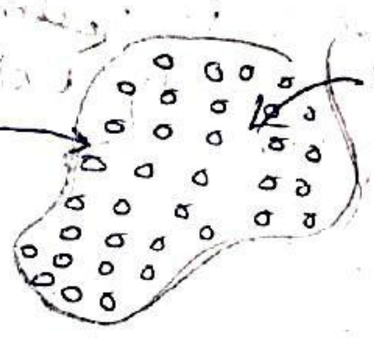
Type of Fossils →

① Unaltered fossils → eg ⇒ Wooly Mammoth.

V. V. I ② Petrefied fossils ⇒ [Deposition of Inorganic substance]
(Maximum)
↳ Mostly Pnt in sedimentory Rocks.

③ Mould

④ Cast = Petrefied mould



⑤ Print

Age of Fossils / Rocks:-

✱ Radioactive dating Technique:-

Eg: Radio-active substance → 100 gm [C^{14}] —(1) 1/2 Life→ (500 gm)
- R.A [C^{14}] —(2) 1/2 life→ R.A (C^{14}) = 250 gm
- N.R.A (N^{14}) = 250 gm.

N.R.A → 500 gm (N^{14})

Ratio of (R.A + N.R.A) substance

25% ⇒ R.A	~~250 gm~~
75% ⇒ N.R.A	= 25 : 75
	= 1 : 3

1st 1/2 life = 1 : 1

IInd Half Life = 1 : 3

Eg → C^{14} (unstable) (5730 ± 40 Y) —1/2 life→ N^{14} (stable)
or (5760 Y)

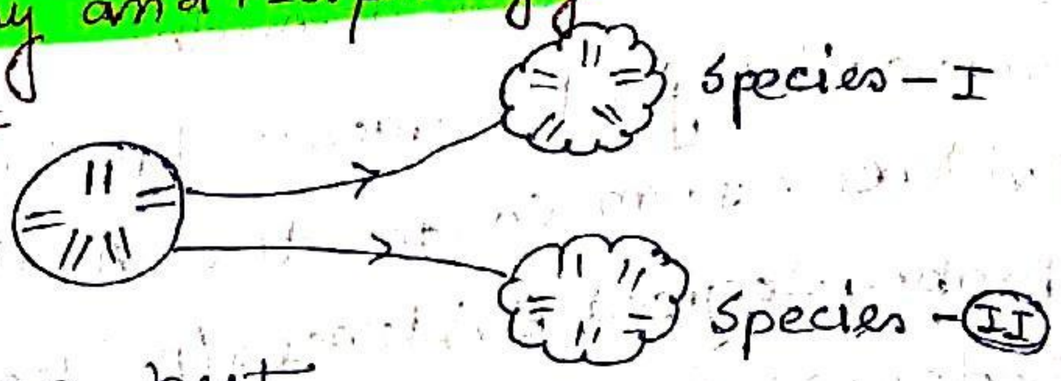
→ U^{238} (unstable) —1/2 life [Million Year]→ Pb^{207} (stable)

V. I

NOTE ⇒ Electron Spin Resonance ⇒ Modern & accurate Technique.
(E.S.R)

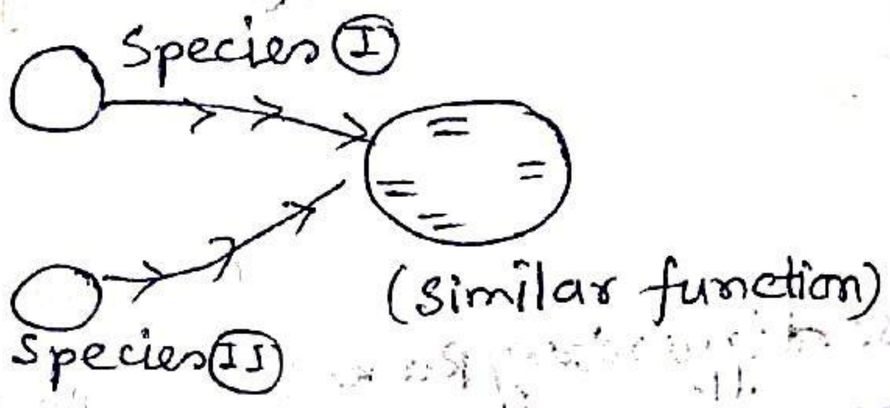
② Evidences from Comparative Anatomy and Morphology

Homologous Organs ⇒ Similar Structure — common Ancestry



- Similar in fundamental structure but are different in functions.
- Divergent evolution
- common ancestry,
- Eg:- ① Forelimbs of man, cheetah, whale and bat. (V.V Imp)
  ② The mouth parts of cockroach, honey bee, mosquito and butterfly.
  ③ Thorn and tendrils of Bougainvillea and cucurbita, represent homology.

Analogous organs:-
Different → structure,



- Different their anatomical structure but similar in functions due to same needs,
- Result of convergent Evolution,

Eg:- ① Wings of butterfly and of birds
② pectoral Fins of sharks and flippers of Dolphin.
③ Strings of honey bee and scorpion.
④ Eye of octopus and eye of mammah.
⑤ sweet potato (Root modification) and potato (stem modification)

③ Vestigial Organs:-

The organs which are present in reduced form and do not perform any function in the body but correspond to the fully developed functional organs of related animals are called vestigial organs.

Eg:- Vestigial Organs in Human Body.
- Nictitating membrane (Plica semilunaris)
- Auricular muscles of ear
- Segmental muscles of abdomen.
- vermiform appendix
- coccyx or tailbone
- Third molars (wisdom teeth)
- Nipples in male.

④ Embryological Evidences (Evidences from Embryology)

- Embryological support for evolution was also proposed by Heckel based upon the observation of certain features during embryonic stage common to all Vertebrates that are absent in adult.
- For example, the embryos of all vertebrates including human develop a row of vestigial gill slit just behind the head but it is a functional organ only in fish and not found in any other adult vertebrates. However, this proposal was disapproved on careful study performed by Karl Ernst von Baer. He noted that ~~embry~~ embryos never pass through the adult stages of other animals.
- Biogenic law → According to Hackel → Ontogeny (development of embryo) recapitulates phylogeny.

⑤ Evidences from Physiology and Biochemistry

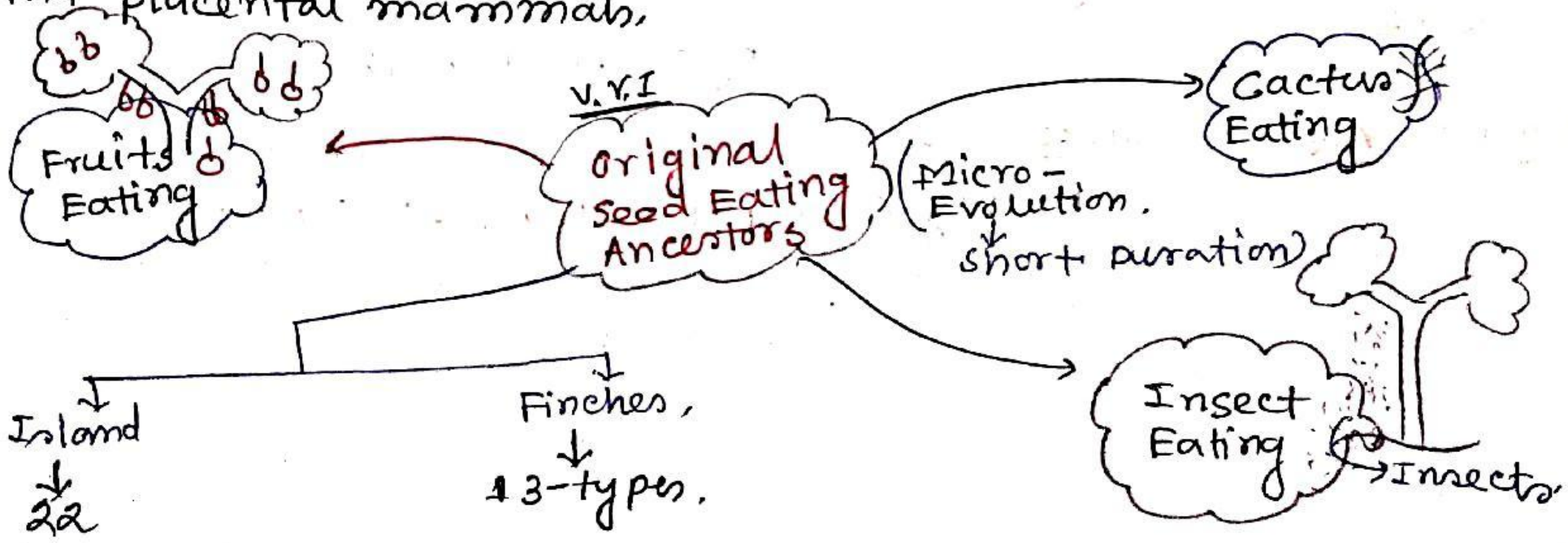
- Similarities in proteins and genes performing a given function among diverse organisms give clues to common ancestry

Eg:- (Pepsin → All vertebrate
Trypsin → All ✗ Invertebrate
→ All vertebrate.)

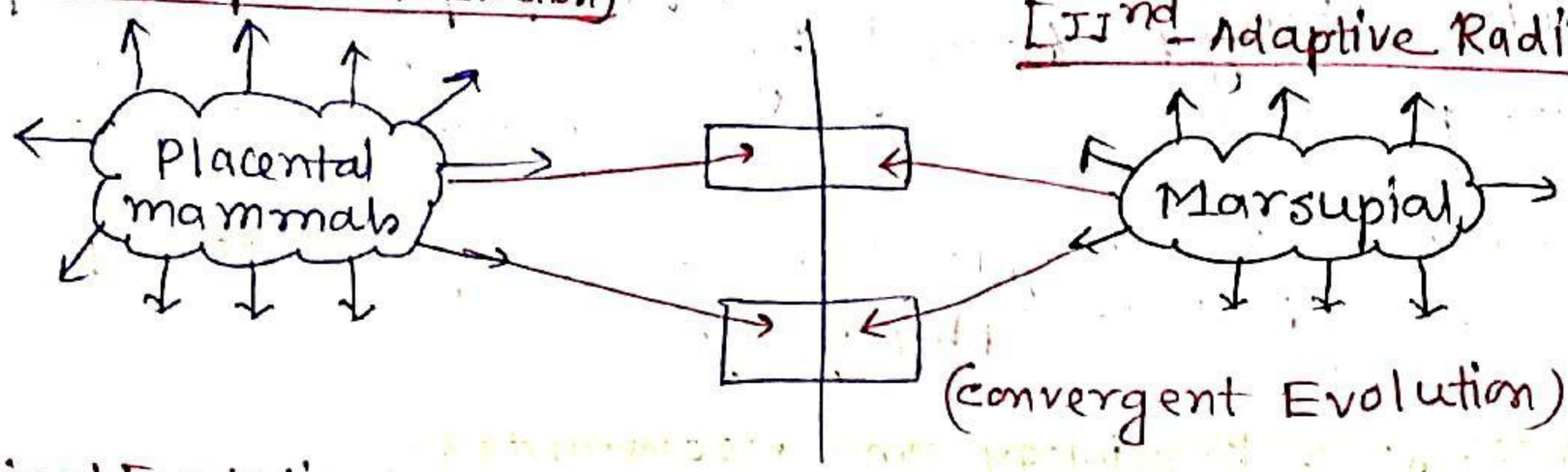
Lec 04

ADAPTIVE RADIATION :-

- During his journey (1831) Darwin went to Galapagos Islands — (22)
- Ship → "H.M.S. Beagle"
- Duration of journey (5) years.
- There he observed and amazing diversity of creatures. of particular interest, small black birds Later called Darwin's Finches amazed him. He realised that there were many varieties of finches in the same island.
- All the varieties are evolved on the island itself. From the original seed-eating features, many other forms with altered beaks arose, enabling them to become insectivorous and vegetarian finches.
- This process of evolution of different species in a given geographical area starting from a point and literally radiating to other area of geography (habitats) is called Adaptive radiation.
- Darwin's finches represent one of the best examples of this Phenomenon. Another example of is Australian marsupials and placental mammals.



- When more than one adaptive radiation appeared to have occured in an isolated geographical area (representing different habits), one can call this convergent evolution.
- Placental mammals in Australia also exhibit adaptive radiation in evolving into varieties of such placental mammals each of which appears to be 'similar' to a corresponding marsupial (eg. → plantal wolf and Tasmanian wolf - marsupial).



Biological Evolution :-

① Lamarck's Theory of Evolution -

- Theory of Inheritance of acquired characters.
  or
  Theory of use and disuse of organ.
- Book = philosophic Zoology.
- **Postulate of Lamarck Theory :-**

① Internal force → ↑ - size of body.
② (Formation of new organs in the result of the need of organism)
③ Development of organs & its use.
④ All changes acquired by organism during its life are transfer to offsprings.

V.V.I
★ Lamarck theory was discarded by

Weisman theory of Germplasm

- Germplasm (gametes) → (Transfer into offsprings.)
- Somatoplasm (somatic cells) → ✗

② Darwinism :-

Theory (1859) → Theory of Natural selection
or
(origin of Species)

Darwin influenced by a artical → An Essay on principles of population.
By ⇒ **T. R. Malthus**

V.V.I

NOTE **Alfred wallace** → • A naturalist, who worked in → Malay Archipelago (present = Indonesia) has also come to similar conclusion around the same time.

Main Points of theory of Natural selection →

① High rate of Reproduction.
② Total no. of almost constant → Resources are limited.
③ Struggle for Existance [(competition)]

- [Intra Specific] → competition b/w members of same Specie
- [Interspecific] → [competition b/w members of different species] → [Responsible for Evolution]

④ Variation and Heridity (continuous variation)

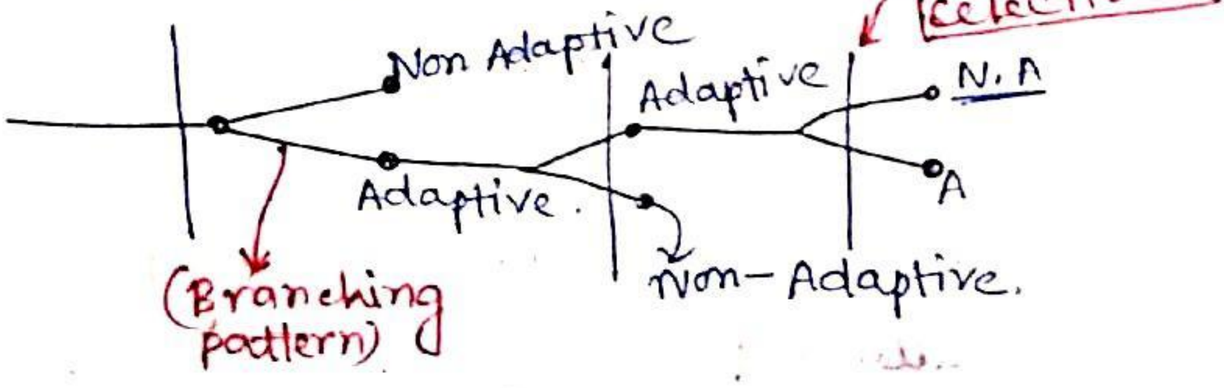
- [Adaptive] → useful.
- [Non Adaptive]

⑤ Natural selection → Individual with [maximum useful variation or Adaptive variation.
Selected by → [nature].

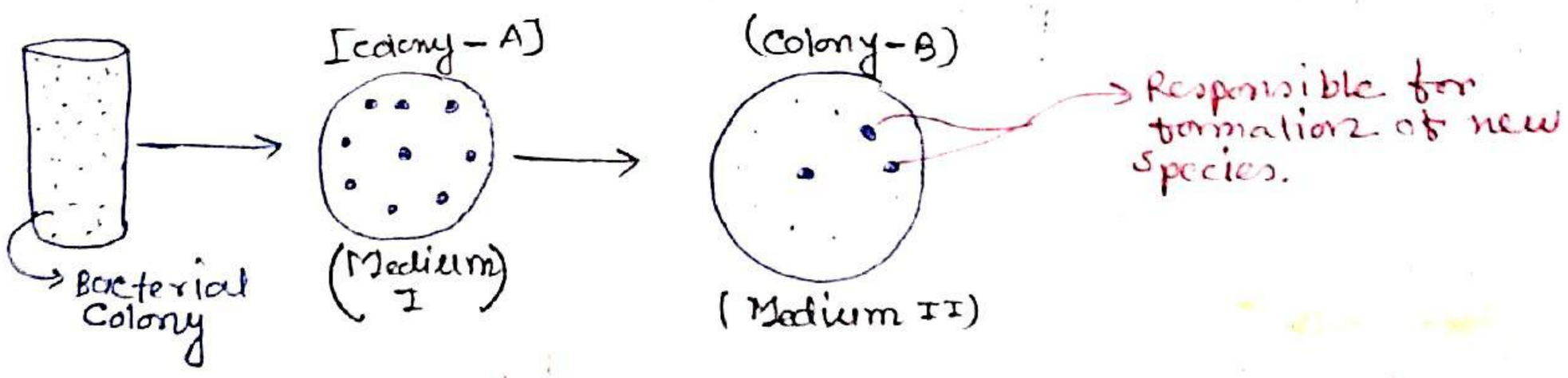
⑥ Survival of the fittest → Fitness is end result of the ability to Adapt and get selected by [Nature].

★ Two key concepts and Darwin theory: (V.V.I)

- [Branching Descent] → (Pattern of Evolution]
- [Natural selection] → [Mechanism of Evdution]



Darwin said that the appearance of new life forms is due to - Accumulation of variation from one generation to another.



NOTE

Other theories of Darwin

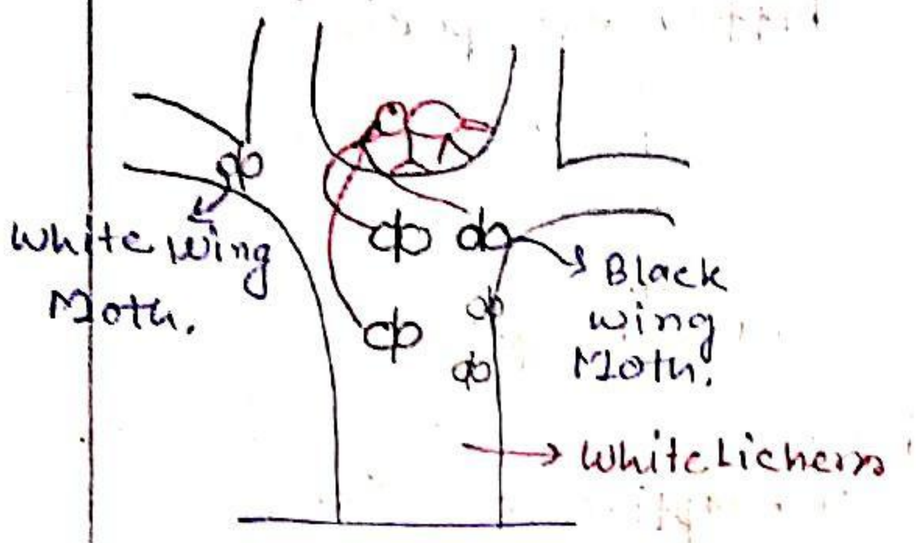
- Theory of Artificial selection
- Theory of sexual selection
- X Theory of pangenesis X
  - Rejected by = Weismann's theory of Germplasm.

Industrial Melanism (Peppered Moth — Biston betularia)

[England]

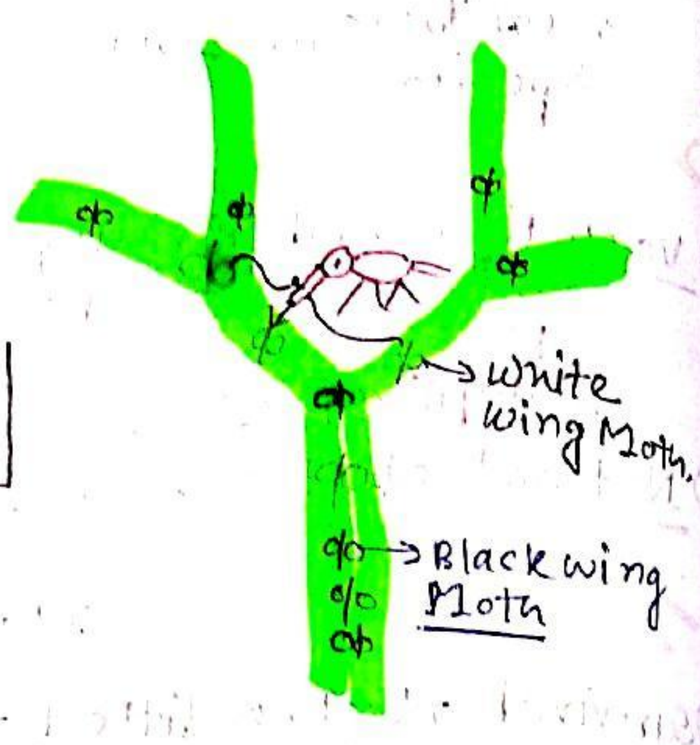
Before Industrilisation [1850]

No. of → Black Moth = ↓
No. of → White Moth = ↑



[1920] After Industrilisation

Black Moth = ↑
White Moth = ↓



(3) Mutation Theory :-

↳ Hugo de vries → work on → Evening primrose (Oenothera lamarkiana)

↳ According to this theory →

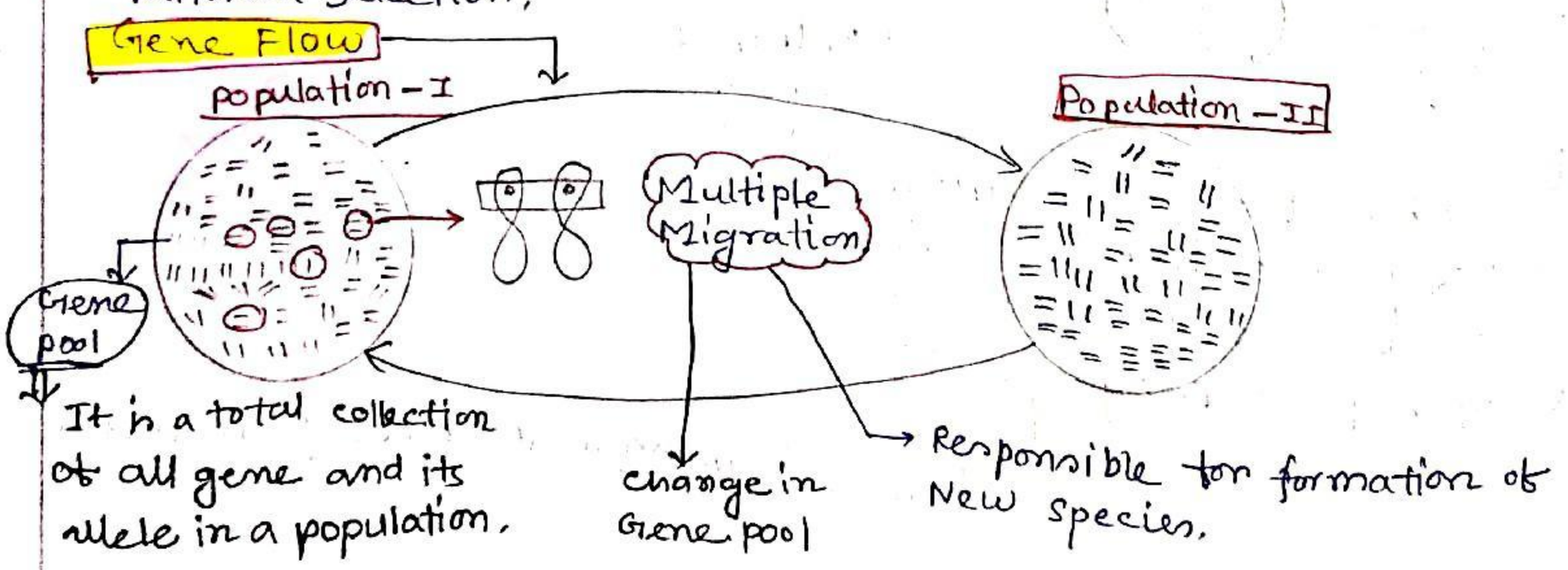
- Mutations are responsible for Evolution.
- Mutations provide raw material for Evolution.
- Mutations are (source of discontinuous variation)

Darwin	Hugo de vries
• variation → small, continuous, Directional, Adaptive	• variation → Large, Discontinuous, Non directional, Random.
Eloution → Slow + Gradual.	• Evolution → Sudden + Jerky process. called → (saltation / single step Large Mutation) (V.V.I)

Modern / synthetic theory :-

- According to this theory → many factors are responsible for Formation of new species →

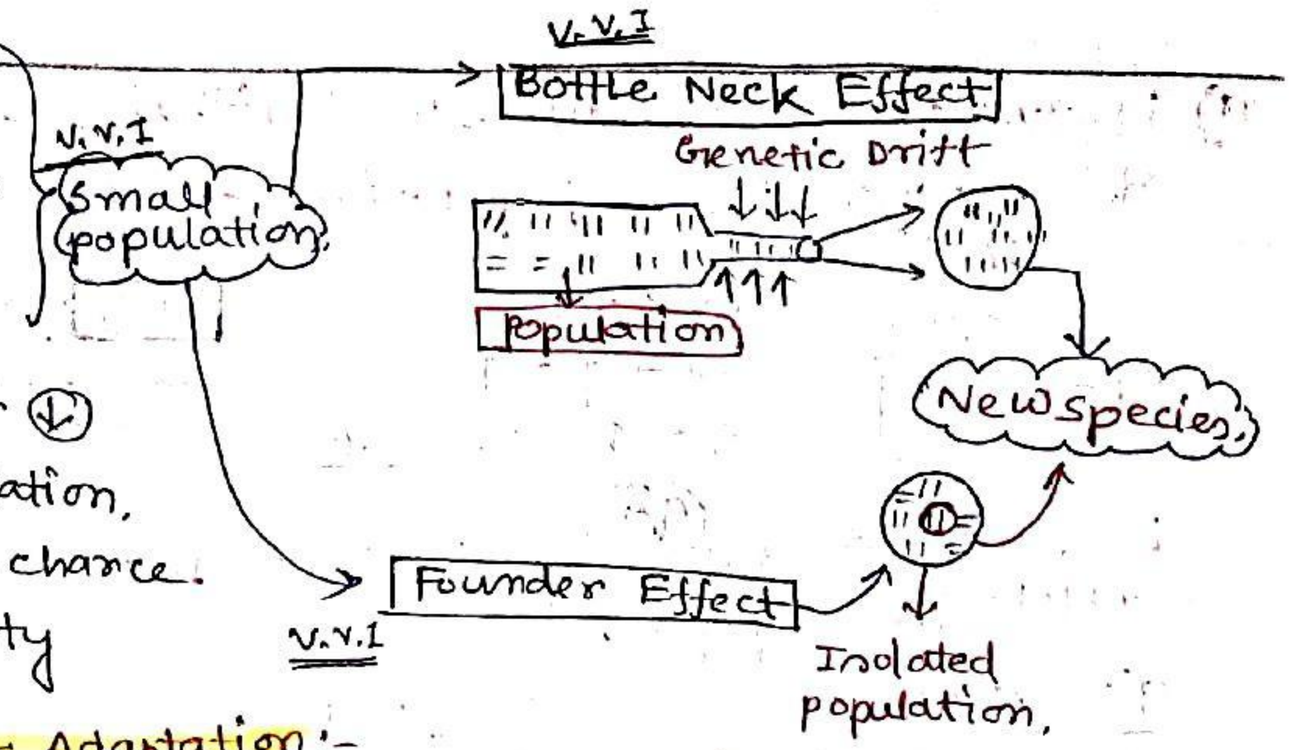
① Gene migration / Gene flow
② Genetic Drift
③ Mutation,
④ Recombination → Regular source of variation.
⑤ Natural selection,



Genetic Drift

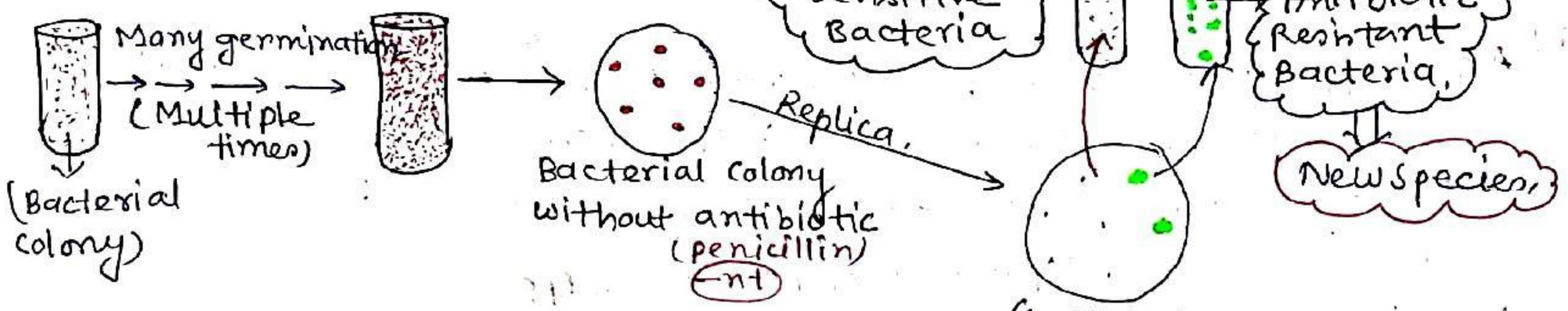
- Random / Nondirectional change of gene frequencies in small population by - chance

- Population size may be → ↑ or ↓ due to →
  - Geographical Isolation,
  - Migration by chance.
  - Natural calamity



Mutation / Genetic Basis of Adaptation :-

Lederberg's experiment :-



- ✱ The new environment does not induce the mutation it only select. the pre-existing / Pre adaptive mutation that occur earlier.
- ✱ over few generation, this would result in speciation.
  - Reproductive Isolation.

Natural selection

(i) Stabilising
(ii) Directional
(iii) Disruptive.

Lec 06

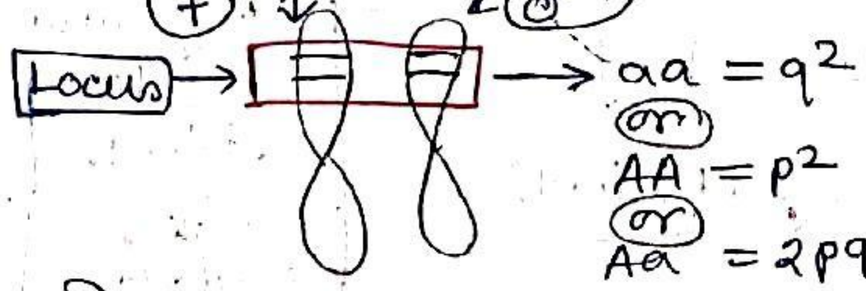
Hardy - Weinberg Principle

- Gene or Allelic frequency in a large population remains constant = (1)

if →
- Mating occur at random
- Absence of above 5-factors →
  1. Mutation
  2. Genetic Drift
  3. Recombination
  4. Gene migration
  5. Natural selection.

V.V.I

Large population → { Frequency of occurance of alleles of gene = constant }



$p^2 + q^2 + 2pq = 1$
or
$(p+q)^2 = 1$
or
$(p+q) = 1$

q) Frequency of an autosomal lithal gene is 0.4. the frequency of carrier in a population of 200 Individual is-

2Pq)

P = 0.4 }
2Pq = ? }

P + q = 1
0.4 + q = 1
q = 1 - 0.4 = 0.6

2Pq = 2 X 0.4 X 0.6 = 0.48 (100 individ
for 200 individual = 2 X 0.48
= 0.96

q) Presence of recessive trait is 16%. the frequency of dominant allele in a population is-

$q^2 = 0.16$
$q = \sqrt{0.16} = 0.4$

P + q = 1
P = 0.6

= 0.6 X 100 = 60%

q) A + Perticular locus, frequency of A-allele is 0.6 and that of a-allele is 0.4, what would be the frequency of Heterozygous in a random mating population = ?

2Pq
P = 0.6
q = 0.4
2Pq = ?

2Pq = 2 X 0.6 X 0.4 = 0.48

[A BRIEF ACCOUNT OF EVOLUTION]

- 1st A cellular Life = 3 BYA
- 1st cellular life (Prokaryotes) = 2 B.Y.A.
- Invertebrate become active = 500 M.Y.A
- 1st - vertebrate (Jawless fish) = 350 M.Y.A.

V.V.I 1st - Jawed Vertebrate = 350 M.Y.A

Eg → Latimeria / coelocanth / Lobefin fish
- → caught in South africa (1938)
- → Living fossil
- → Thought to be extinct

1st Amphibia = Extinct → Invaded Land after Plant.

1st - Amphibia

[Frogs and salamander]

Early Reptiles (Extinct)

Birds

Mammals.

V.V.I
- Dinosaurs (Extinct)
- Turtles
- Lizards
- Snakes
- Tuatara
- Crocodiles

Survived.

some back into water (200 mya) = Icthyosaurs.

Dinosaurs → Dominating Land reptiles in jurassic period (150 mya)

Biggest Dinosaurs ever →

Tyrannosaurus rex (height = 20 feet)

⇓

About = (65 mya) dinosaurs suddenly disappeared from earth.
(In Cretaceous period)

Evolution of [In Cretaceous period]
- → Modern Birds.
- → Mammals → viviparus, More intelligent
- → Flowering plants (Angiosperms).

ORIGIN AND EVOLUTION OF HUMAN

① **Dryopithecus**
Most distant ancestor of hominids.

② **Sivapithecus**
Origin of anthropomorphic monkeys and hominids.

③ **Australopithecus**
Considered the first hominid. walked upright.

④ **Homo habilis**
used rudimentary tools and instruments made of stone

⑤ **Homo erectus**
carved stones and controlled fire.

⑥ **Homo Sapiens** (neander-thalensis)
Made a great variety of specialised tools from stone.

⑦ **Homo Sapiens Sapiens** (Cromagnon)
same physical aspect as present day humans. created cave paintings and stone carvings.

↓

⑧ **Homo Sapiens**

Primates
- → pro-simians → lemur, Loris etc.
- → **Anthropoids (Simians)**

① **Monkey**
- → New world Monkey
  eg → Spider monkey.
- → old world Monkey.
  eg → Rhesus Monkey

V.V.S [closed to Human]

② **Apes**
- → Gibbon (100cc)
- → oranguton (400cc)
- → Gorilla (550cc)
- → chimpanzee (400cc)

V.V.S [closed to Human]

③ **Human**

⊙ Rama-shiva pithecus

⊙ Australopithecus (Ape-Man) (500 – 700cc)

⊙ pre historic Man.
- Homo habilis (650 – 800cc)
- Homo erectus (900cc)

• **Modern Man**
- Neander-thal (1400cc)
- Cromagnon (1600cc)
- Homo-sapiens sapiens (1400cc)

cc → cubic c.m

Chromosomal similarity b/w Human & chimpanzee

Chromosome - 3 | Chromosome - 6

- No. of chromosome
  - Apes = 48
  - Human = 46
  - DNA content 100% same

⊙ Banding pattern of chromosome ⇒ 3 & 6 of Human and chimpanzee = 100% same/similar.

Note:-

According to Mitochondrial DNA

⊙ All Human races originate from one Homo sapiens ancestor in Africa.

Origin of man →

- 15 M.Y.A
  - Dryopithecus. [Africa + Europe] → • Ape like, • Eat Fruits.
  - Rama pithecus, [India] → • Man like, • Eat Hard nut & Seed.
- Dryopithecus + Rama pithecus → walk like gorilla and chimpanz
- 3-4 M.Y.A (NCERT) → Man like primates
  - With Hominid feature
  - Discovered in Ethiopia & Tanzania.
  - Height = 4 feet
- Australopithecus [500-700 cc] (2-5 MYA)
  - 1st – Ape man.
  - 1st – Hominid – 1st – Bipidal Locomotion.
  - 1st – Erect Man
  - Lived in = East Africa
  - Australopithecus Africanus → African ape man
    - Tuang baby → Skull of 4-6 Y Baby
  - Australopithecus Afarensis → Lucy
- ⊙ Hunted with stone weapons → For Protection.
- • Eat = Fruits

Pre-Historic Man.

① Homo habilis (2 M.Y.A) (East Africa)
- Skill-full man / Tool maker / Handy Man
- 650 – 800 cc.
- 1st – Human being like
- Probably not eat meat

② Homo erectus (1.5 M.Y.A)
- 900 c.c
- carnivorous.
- 1st – Man used fire for Hunting, protection and cooking.
- Complete erect
- • Java-man (Indonesia)
- • Peking-man (Beijing)
- • Heidelberg (Germany)

Modern Man →

① Neanderthal (100000 – 40000 Y.B)
- → 1400 cc (like Homo sapiens)
- → Near east central Asia
- → Speech centre developed.
- → Civilisation start
  - → made huts
  - → used Hides for protect their body
  - → started buried the dead
    - ↳ Immortality of soul.

② Cromagnon [50,000 – 10,000 Y.B]
- → 1600cc
- → painting on cave wall (18,000 Y.B) NCERT)
  - • (Bhimbetka rock shelter in Raisen district of Madhya Pradesh)

③ Homo-Sapiens – Sapiens. [10,000 Y.B]
- → 1400cc
- → Agriculture started.