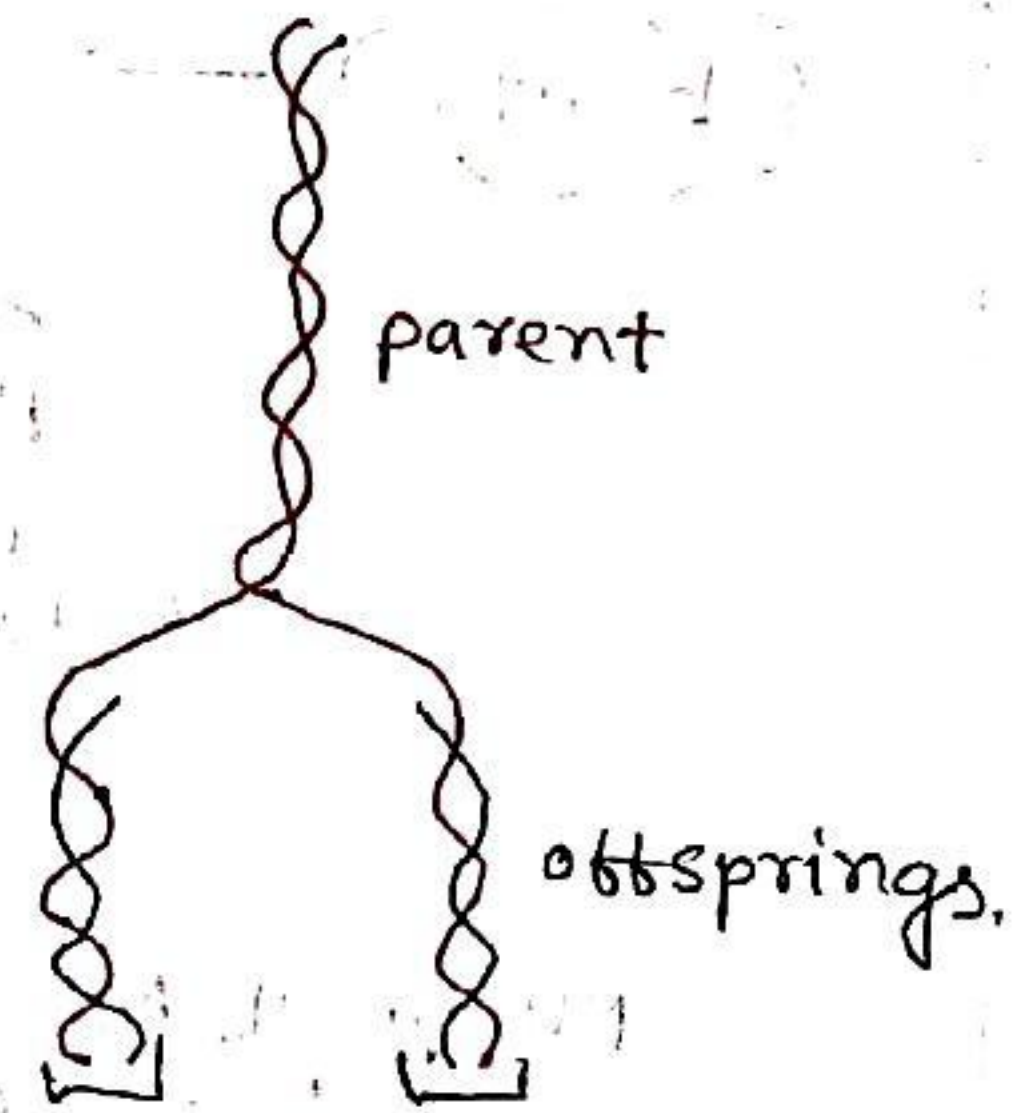
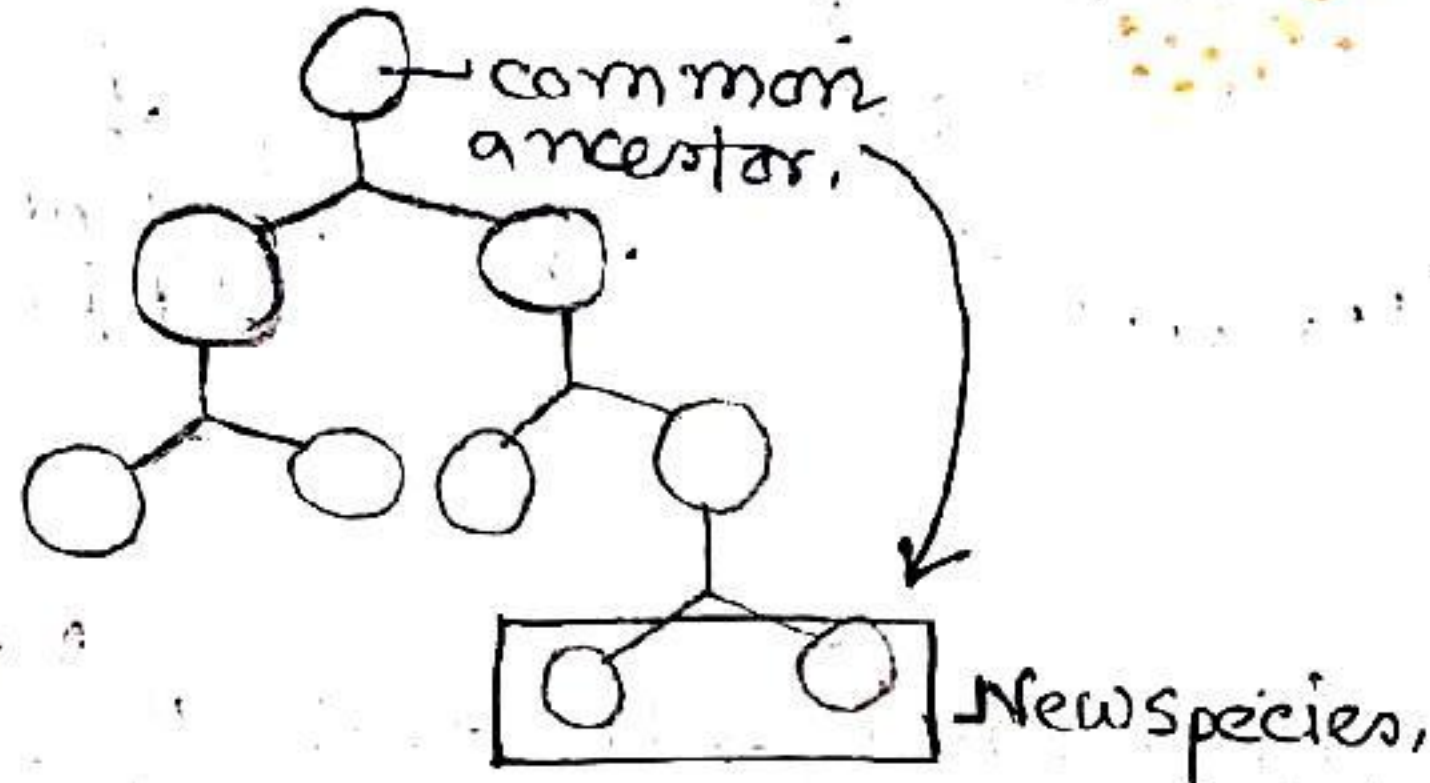


Origin of Life

Evolution

- Evolutionary Biology → 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 to 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 years 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 Bang 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

→ polysaccharides etc.

[cellular]

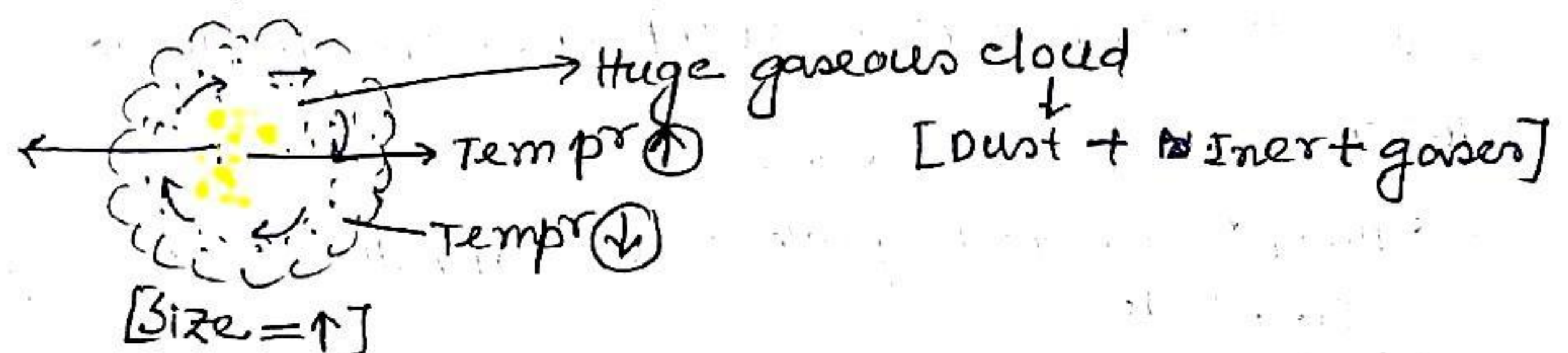
[2.0 B.Y.A]

→ unicellular

→ multicellular.

Big Bang Theory

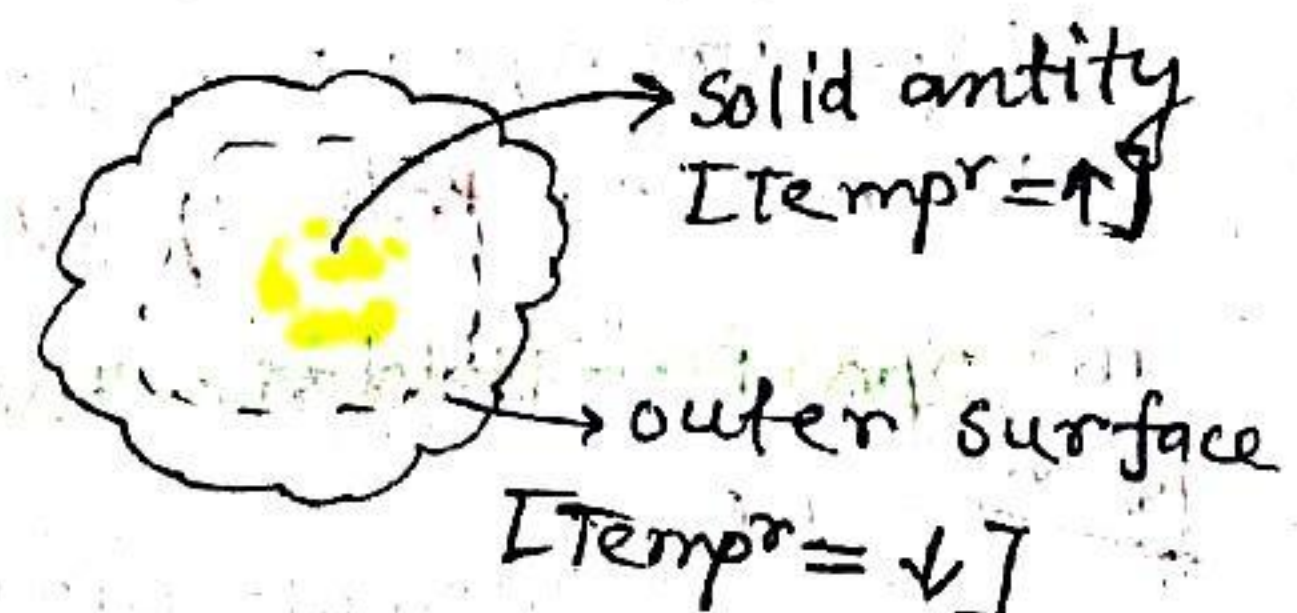
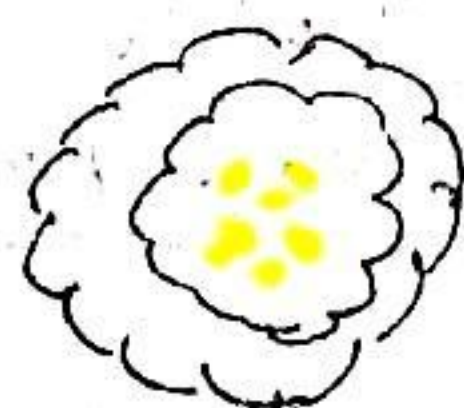
Solid entity

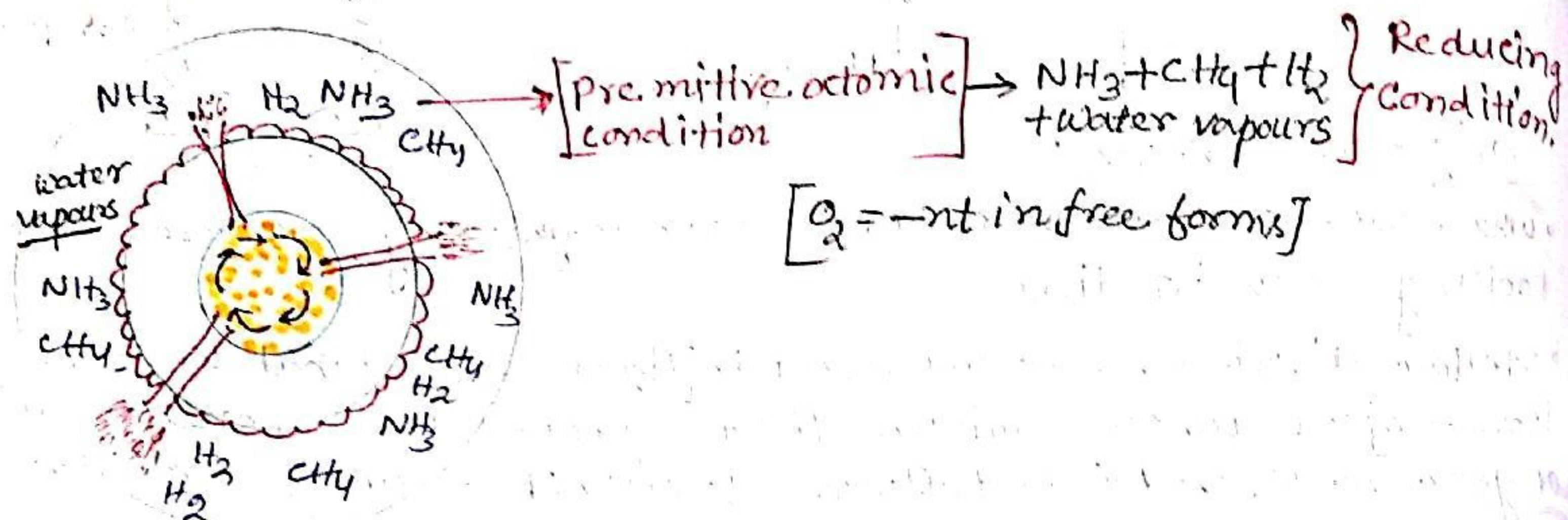
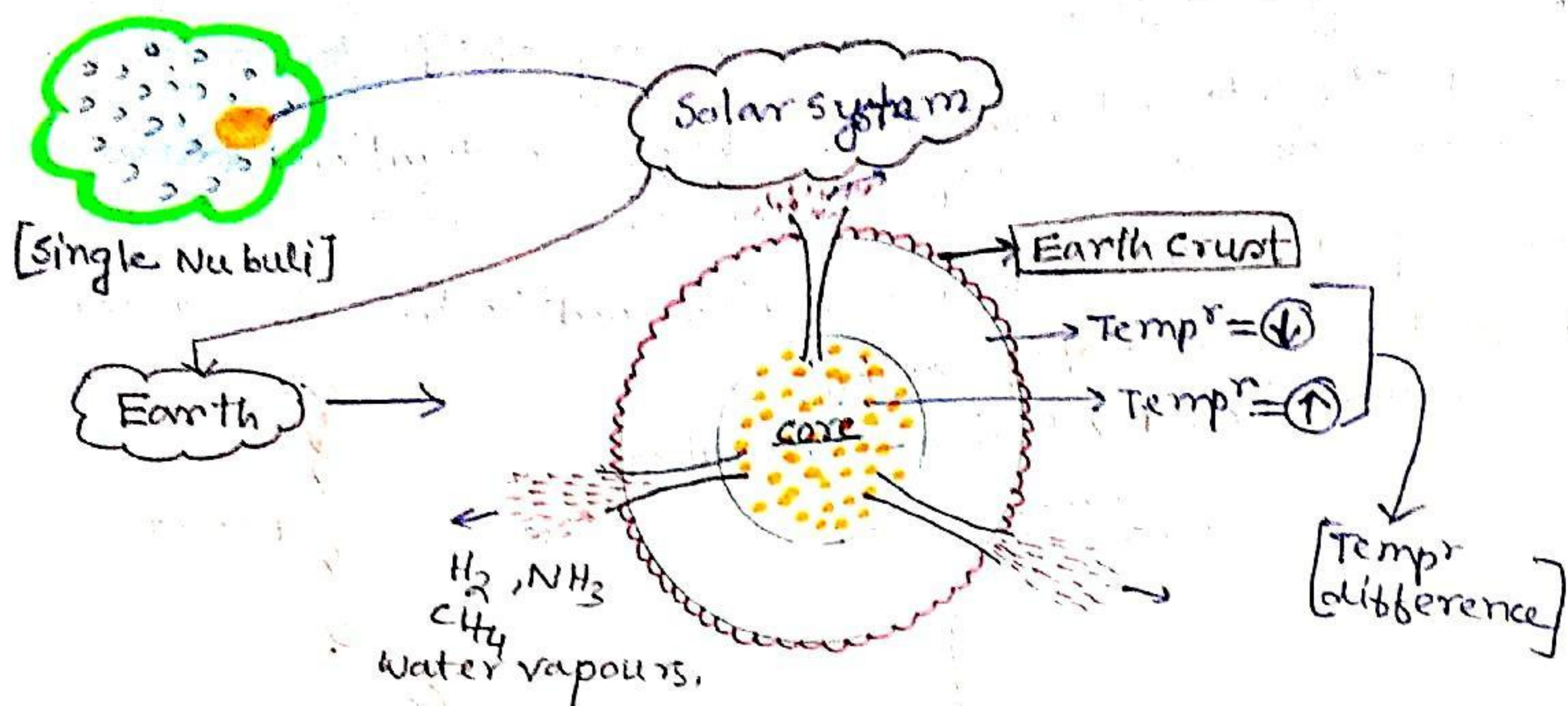


Single Huge Explosion (Big Bang)



Million.





Theories to Explain origin of life:-

- ① Theory of Special creation.
- ② Theory of catastrophism.
- ③ Theory of panspermia / 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 were produced from wheat grain kept with a shirt drenched in sweat.

- ⑤ Theory of Biogenesis:-

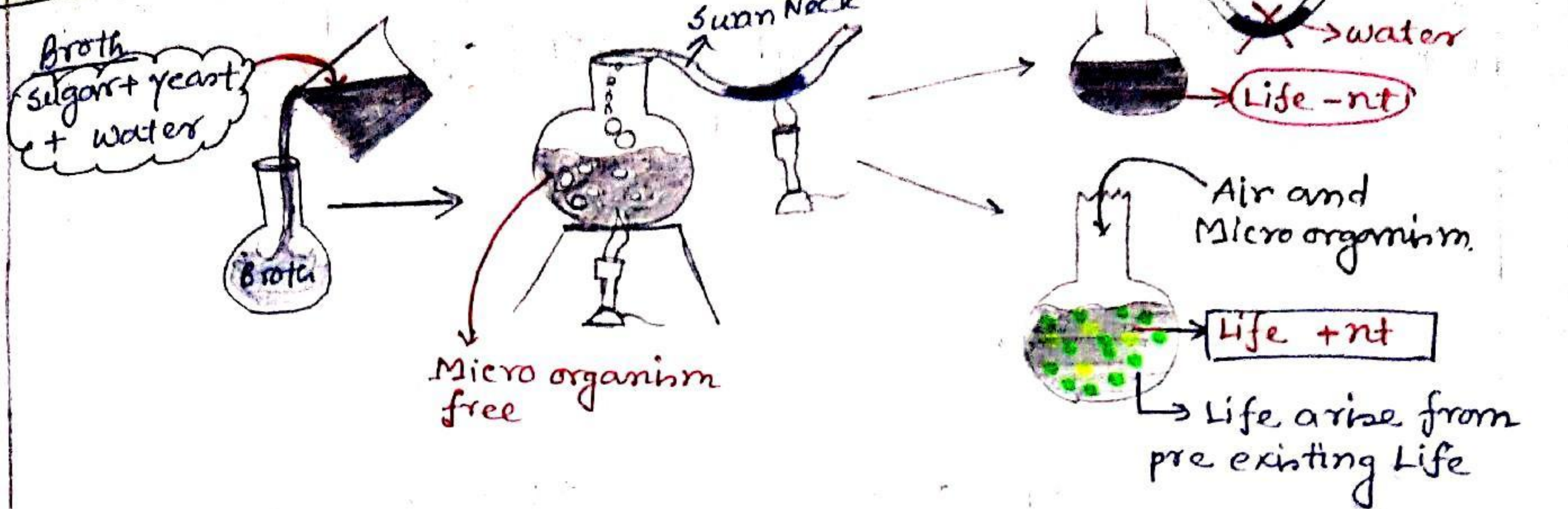
- The Theory of Spontaneous generation was disproved by many scientists.
- They proved that new organisms can be formed from preexisting ones, i.e., omnis vivum ex vivo. Noted scientists who experimentally challenged the theory were, Francesco Redi, Spallanzani and Louis Pasteur.

- 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

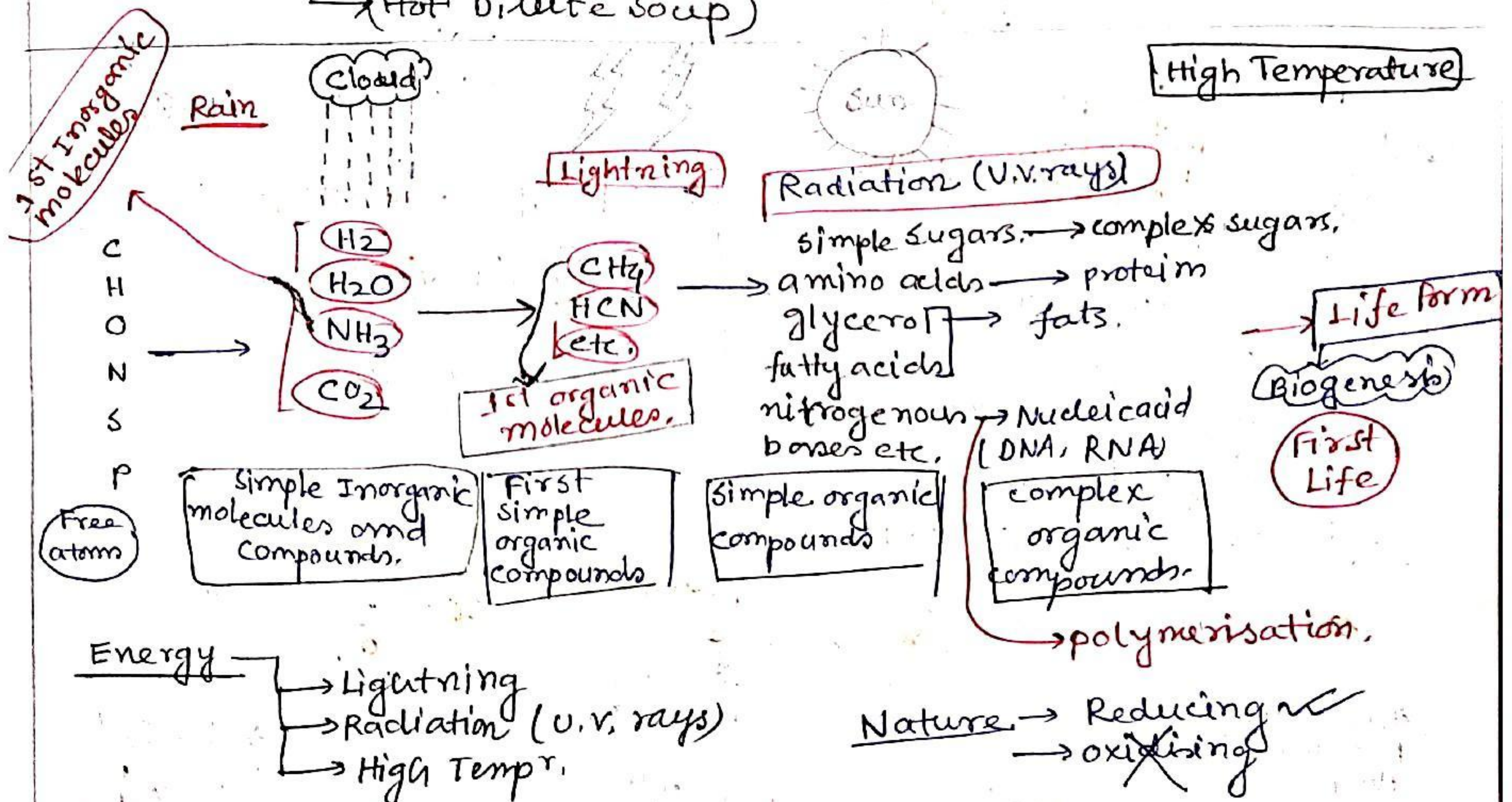
- The above mentioned simple molecules combined to form complex biomolecules in water in presence of following energy sources:-
 - Heat from volcanic eruption
 - Lightning from clouds.
 - UV rays and X-Rays → Radiation.

SEE NCERT

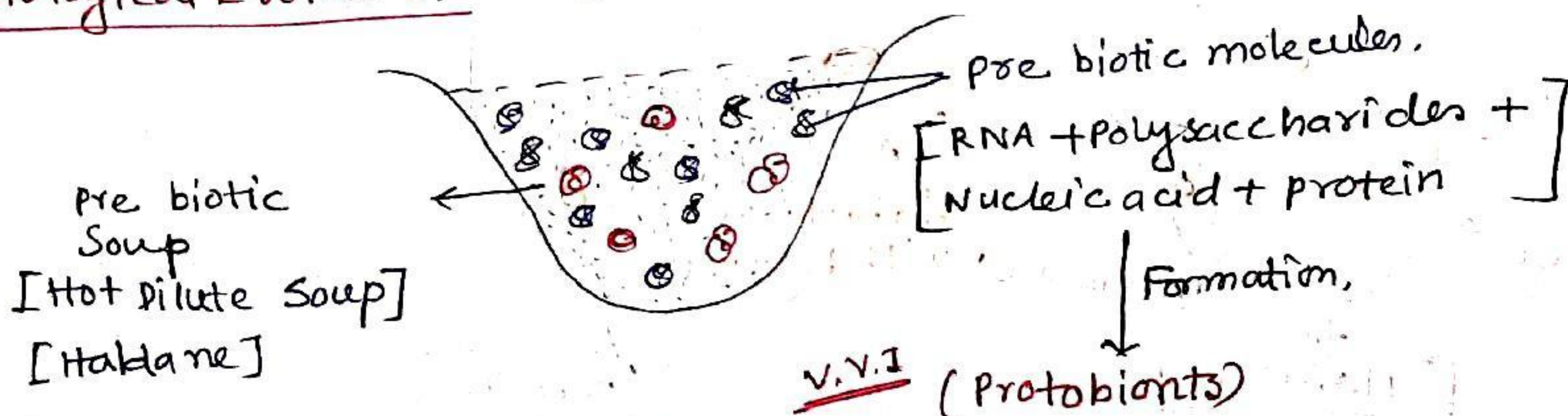
↓ Miller's Experiment

- Life originated in water.
 - Alexander I Oparin was a Russian biochemist.
 - He wrote the book 'origin of Life'.

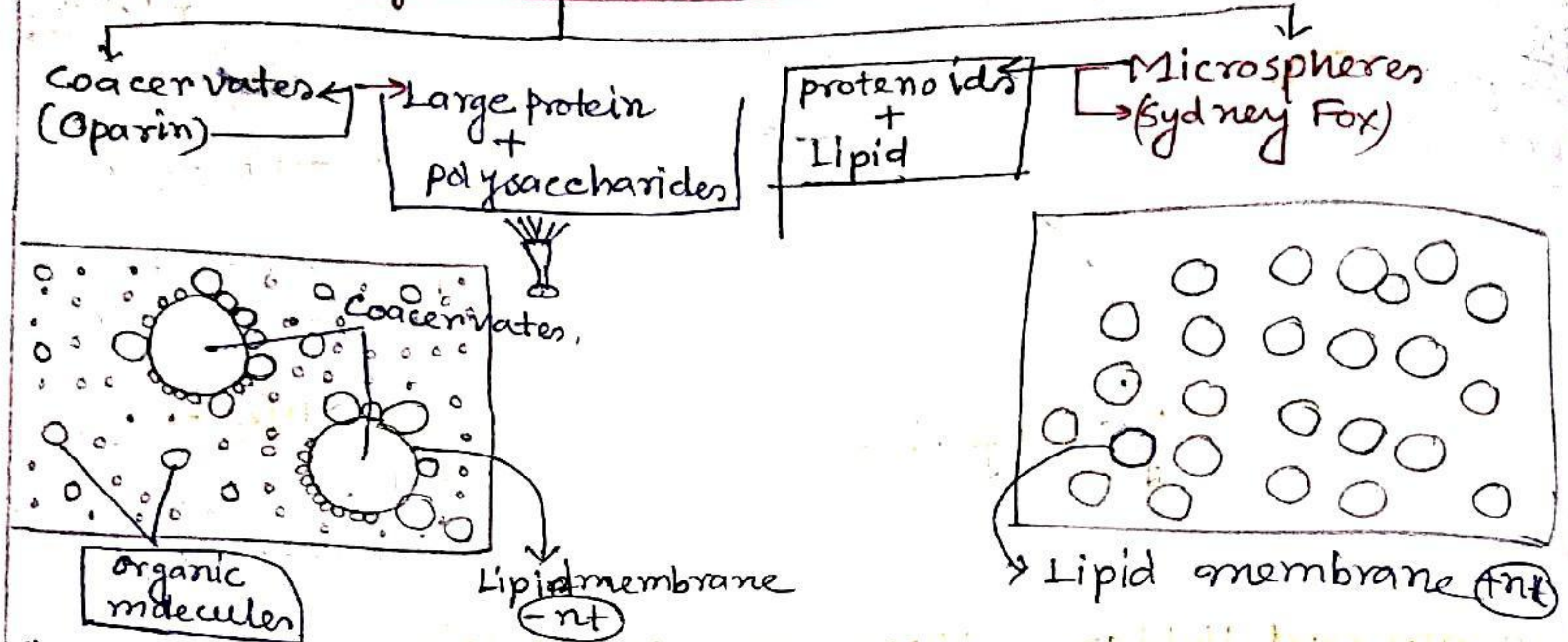
- J.B.S Haldane was an English physiologist who later on settled in India in Bombay (Hot Dilute Soup).



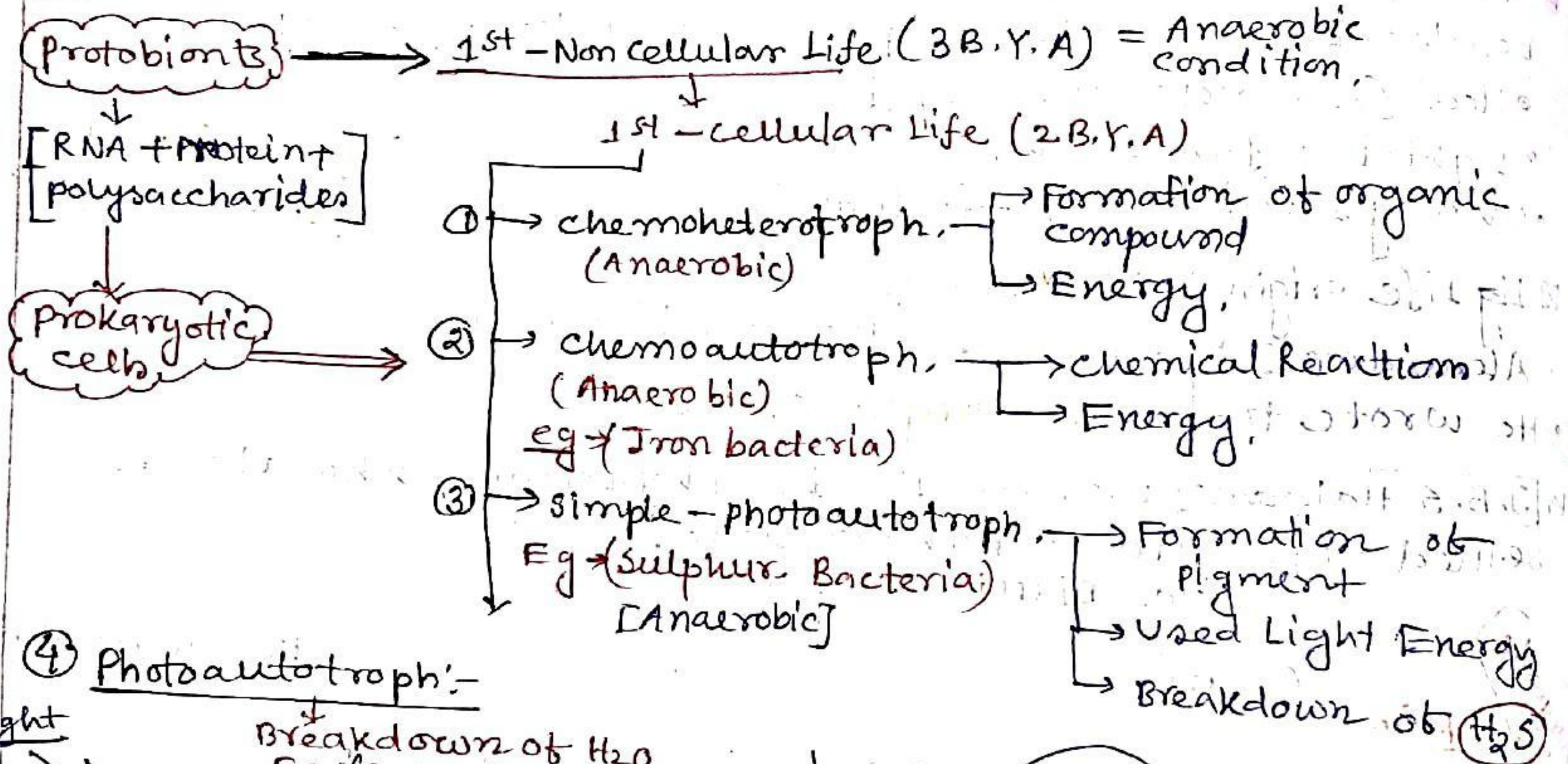
Biological Evolution:-



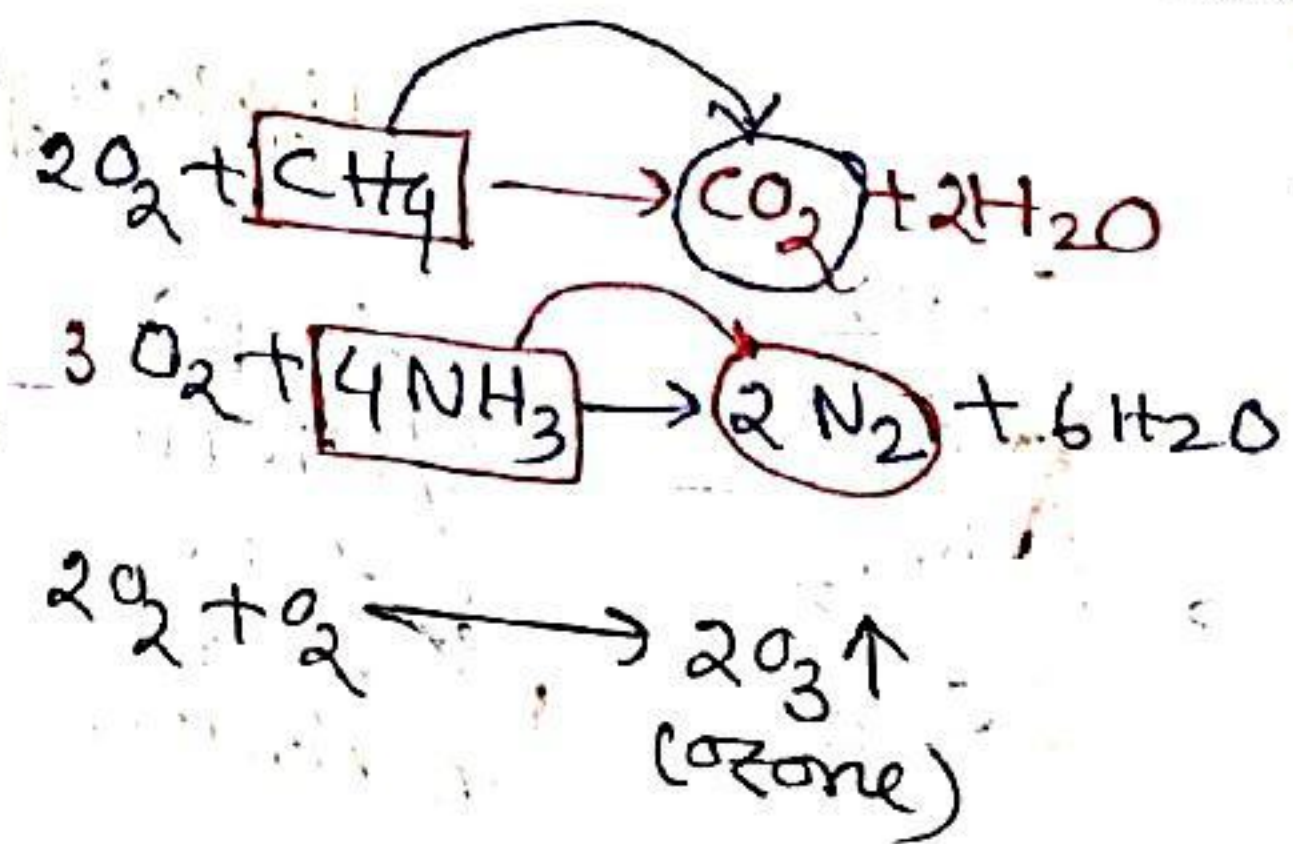
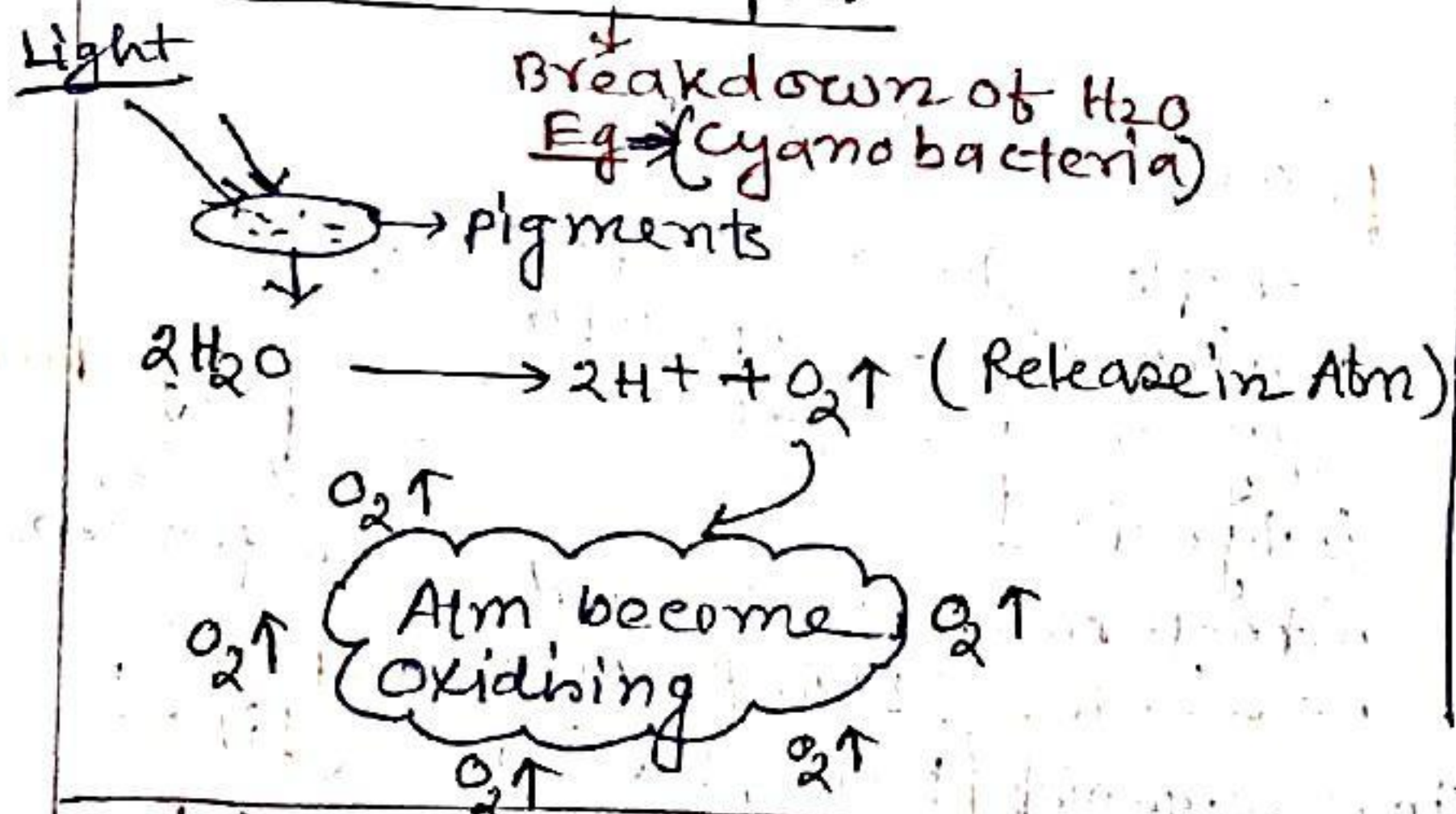
Type of Protobionts



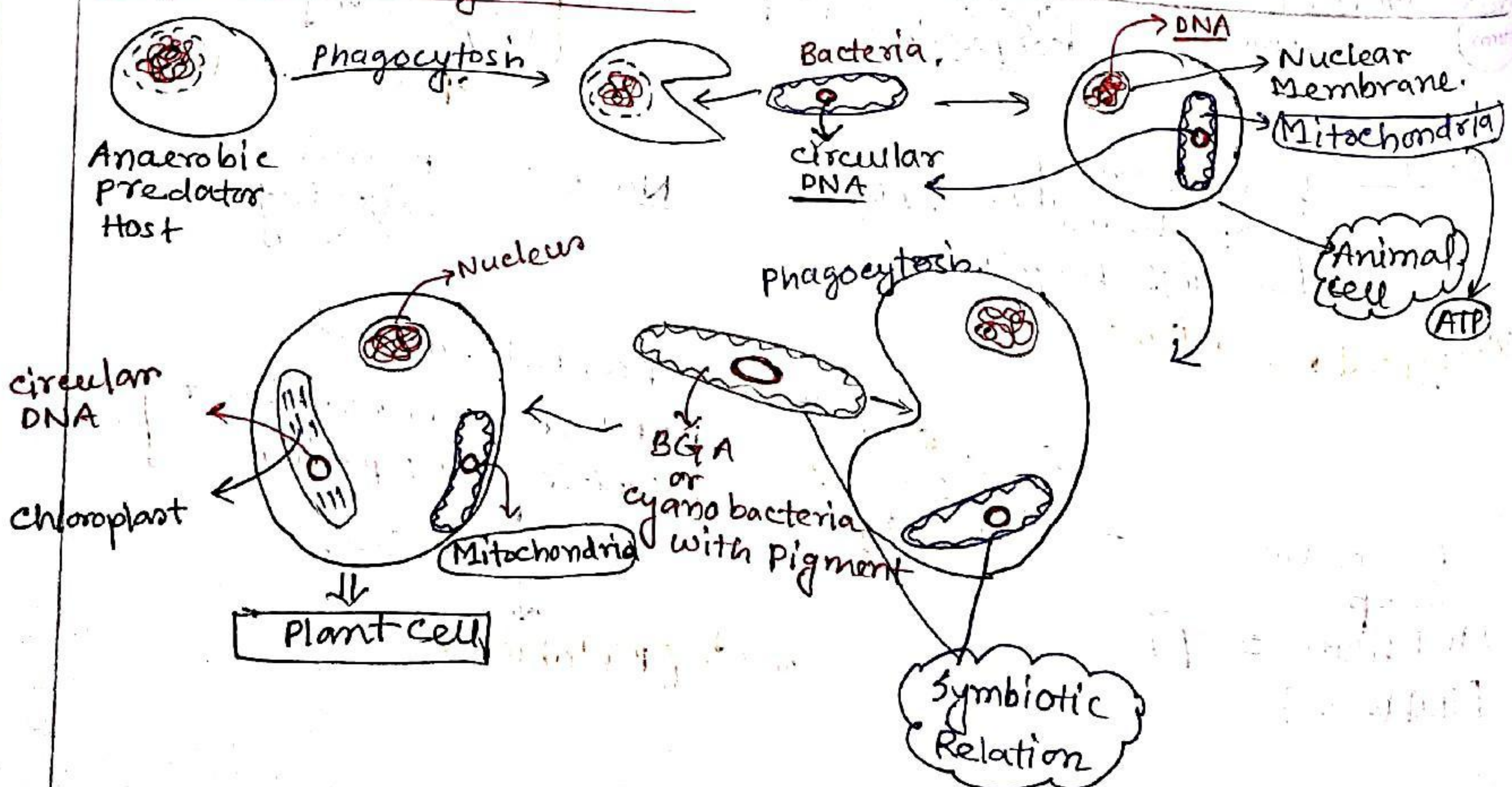
Simple types of Metabolism



④ Photoautotroph:-



origin of Eukaryotic cell:-



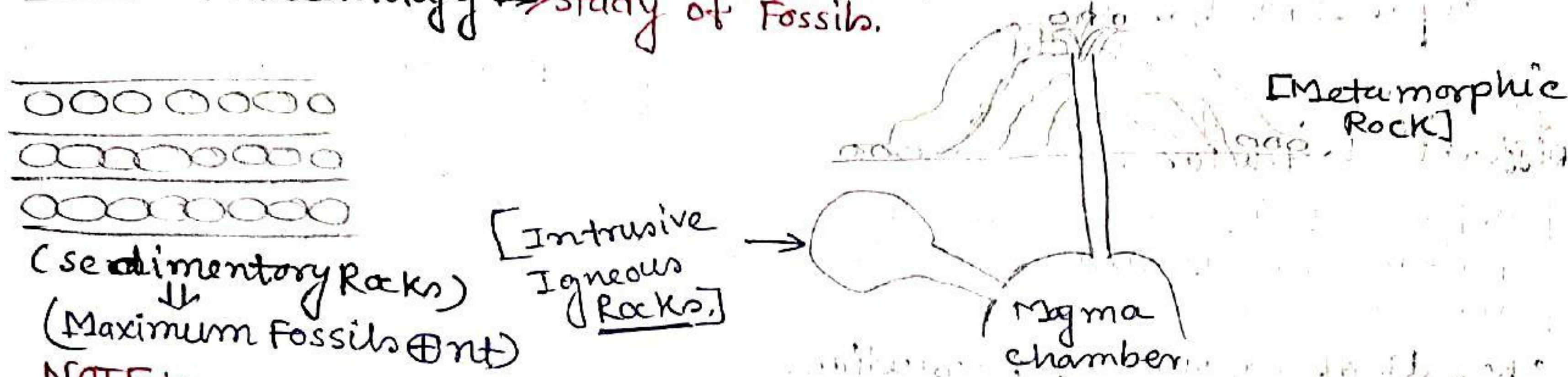
Evidence in favour of Evolution

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

Palaeontological Evidences (Evidences from Fossil Record)

Fossil → 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.

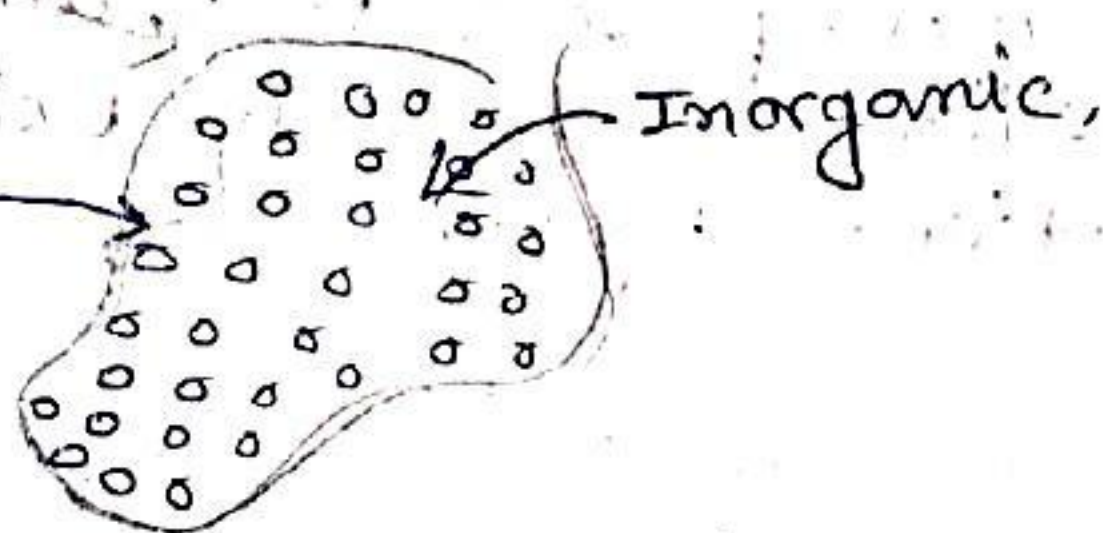
NOTE → Palaeontology → Study of Fossils.



NOTE:-

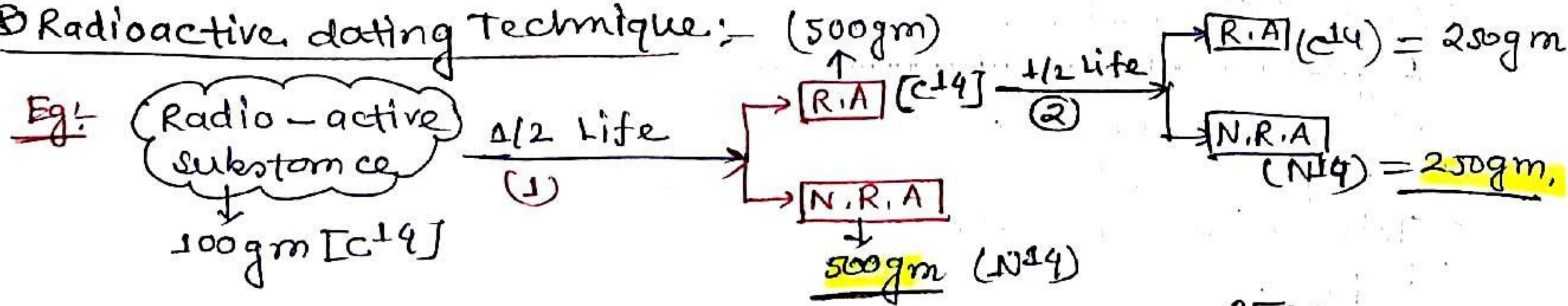
Type of Fossils →

- ① Unaltered fossils → eg → woolly Mammoth,
- ② Petrified fossils → [Deposition of Inorganic substance]
 (Maximum) → Mostly + in sedimentary Rocks.
- ③ Mould
- ④ Cast = Petrified mould
- ⑤ Print



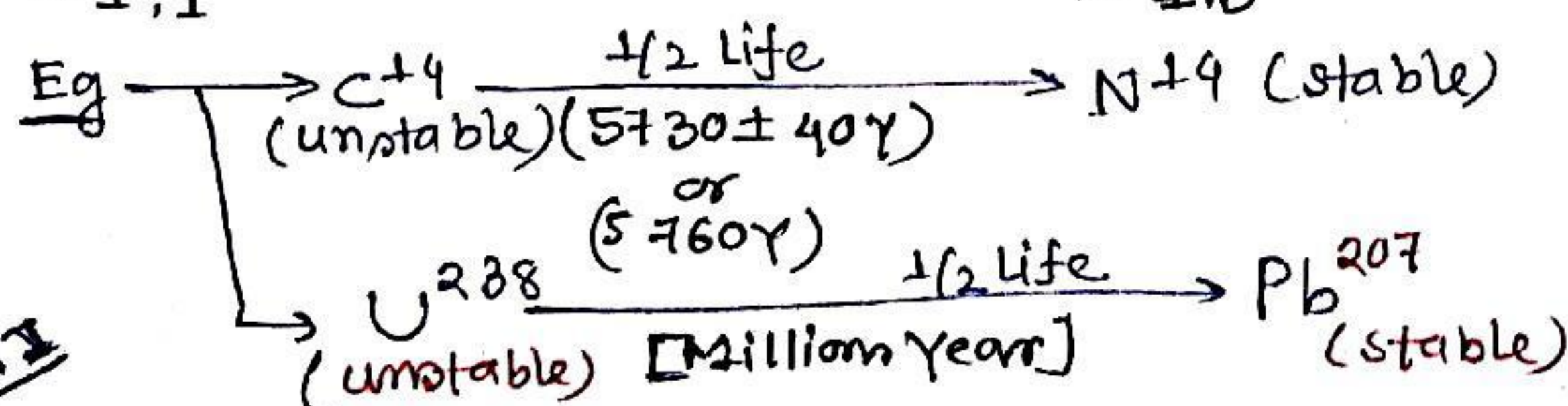
Age of Fossils / Rocks:-

Radioactive dating Technique:-



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

1st 1/2 life = 1:1 2nd Half Life = 1:3



NOTE → Electron Spin Resonance ⇒ Modern & accurate Technique. (F.S.D)

② Evidences from Comparative Anatomy and Morphology

Homologous Organs ⇒
Similar Structure

Common
Ancestry



• Similar & fundamental structure but are different in functions

• Divergent evolution

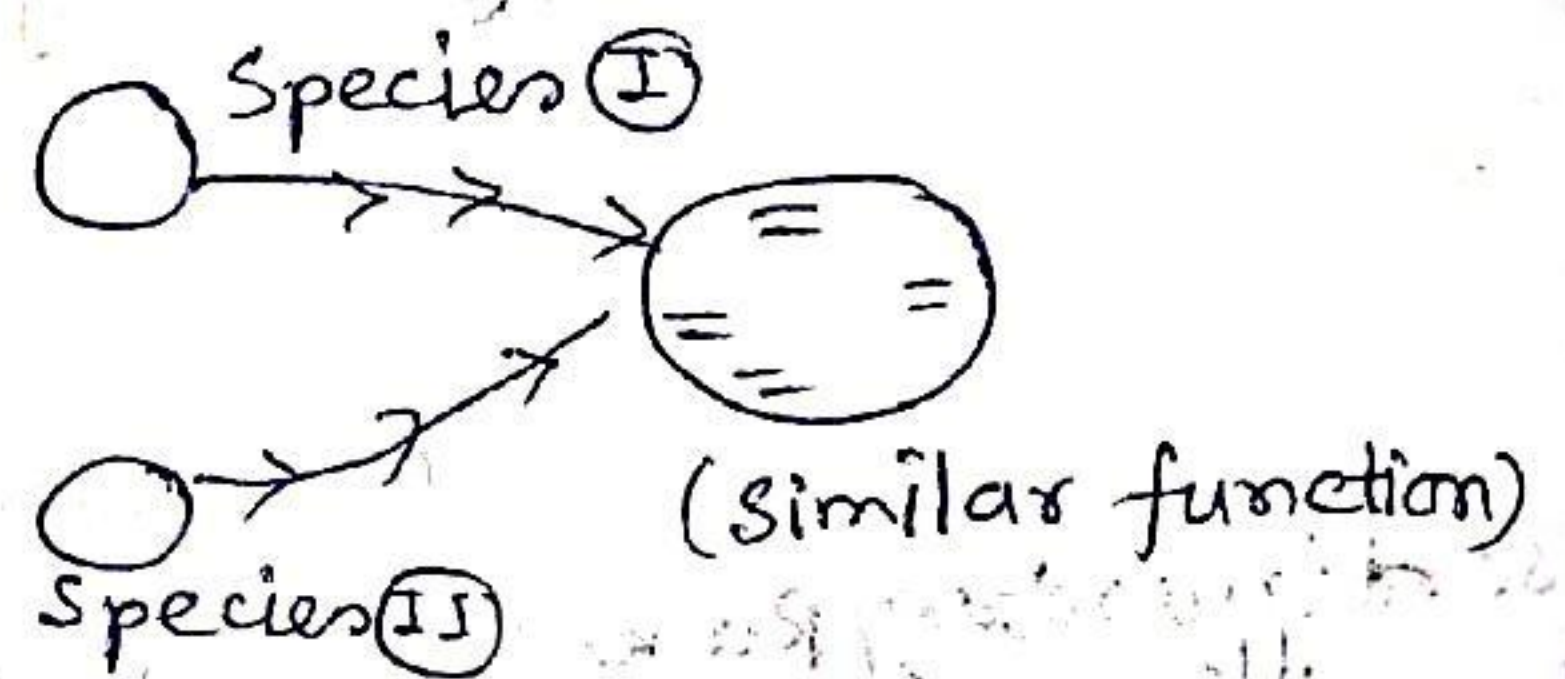
• common ancestry

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.

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 mammal
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 ~~embryo~~ embryos never pass through the adult stages of other animals.
- Biogenic Law → According to Haeckel → Ontogeny (development of embryo) recapitulates phylogeny.

⑤ Evidences from Physiology and Biochemistry

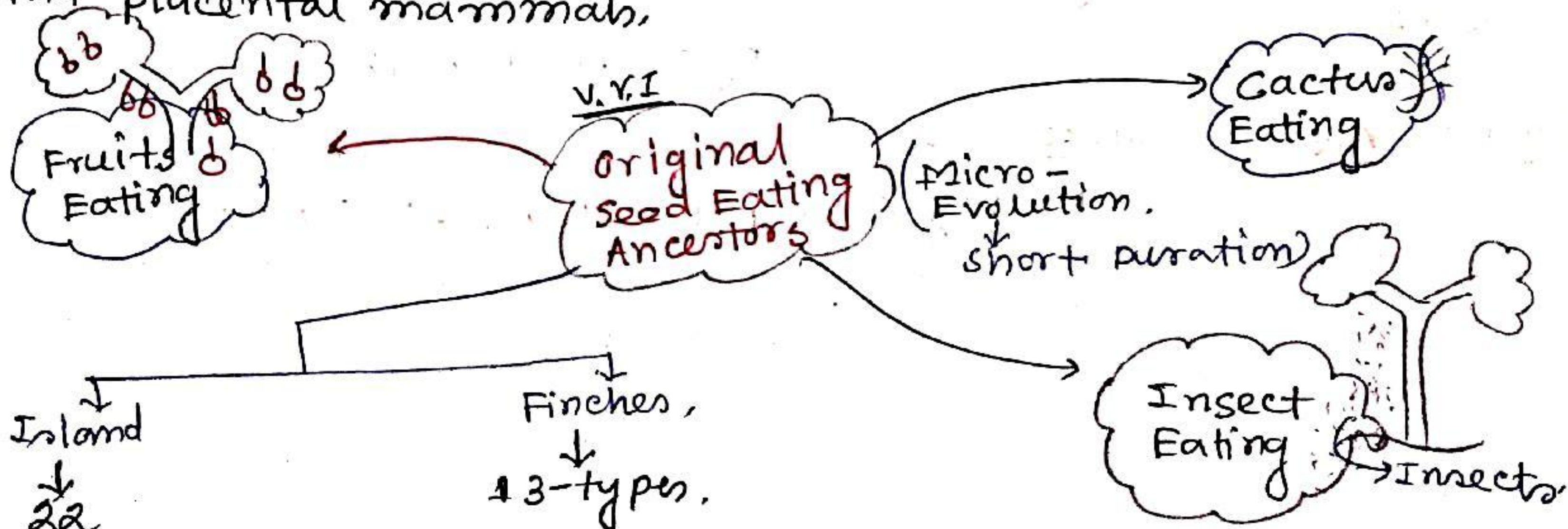
- Similarities in proteins and genes performing a given function among diverse organisms give clues to common ancestry.

Eg: $\left(\begin{array}{l} \text{Pepsin} \rightarrow \text{All vertebrate} \\ \text{Trypsin} \rightarrow \begin{array}{l} \text{All \& Invertebrate} \\ \text{All vertebrate,} \end{array} \end{array} \right)$

Lec
04

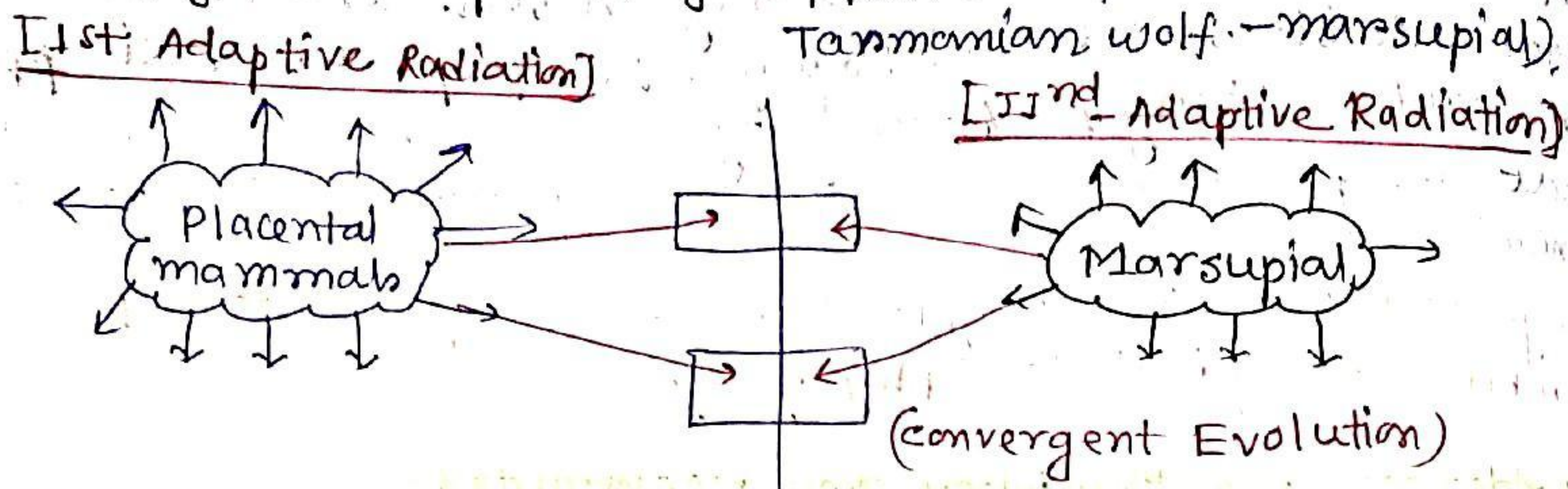
ADAPTIVE RADIATION:-

- During his journey (1831) Darwin went to Galapagos Islands - (22)
- Ship → "H. M. S. Beagle"
- Duration of Journey 5 years.
- There he observed an 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 is Australian marsupials and placental mammals.



• When more than one adaptive radiation appeared to have occurred 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. → placental 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 organ in the result of the need of organism)

③ Development of organ & its use.

④ All changes acquired by organism during its life are transfer to offsprings.

★ V.V.I
Lamarck theory was discarded by

Wehrman theory of Germplasm

↓
Germplasm
(gametes)

↓
(Transfer into offsprings.)

↓
Somatoplasm → X
(somatic cells)

② Darwinism:-

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

Darwin influenced by a article → An Essay on principles of population.

By → T.R. Malthus

(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 Existence (competition)

[Intra Specific]

↓
Competition b/w
members of same
Species

[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.

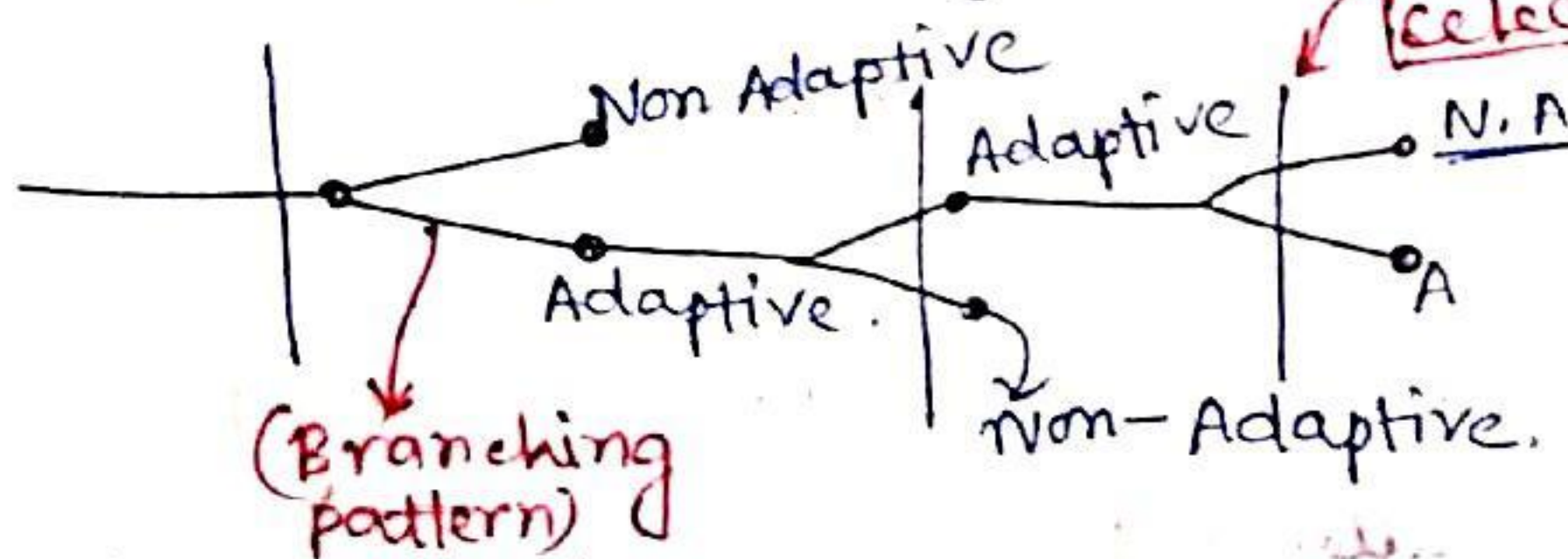
- ⑥ Survival of the fittest → Fitness is end result of the ability
to Adapt and get selected by Nature.

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

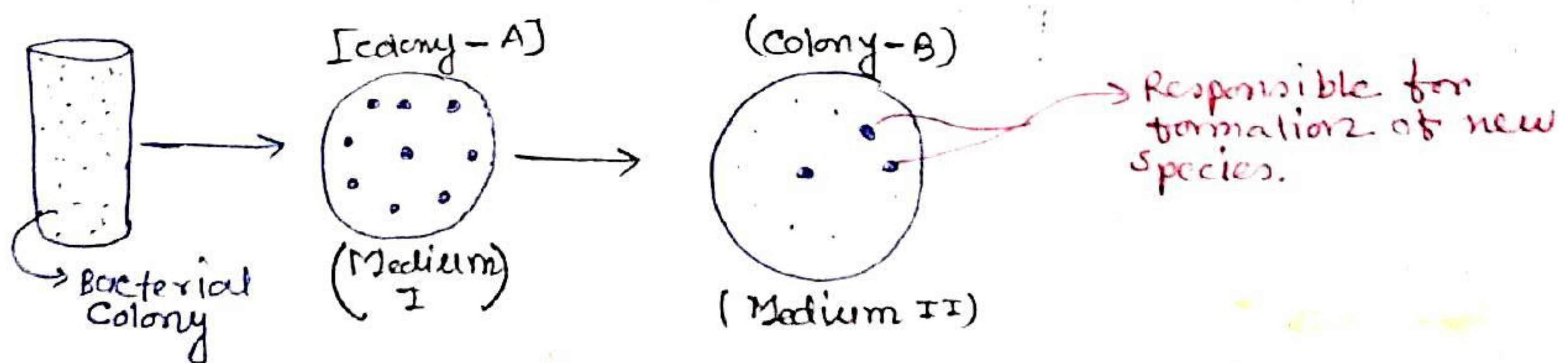
↓
[Branching Descent]
→ (Pattern of Evolution)

↓
[Natural selection]

↓
[Mechanism of Evolution]



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



NOTE

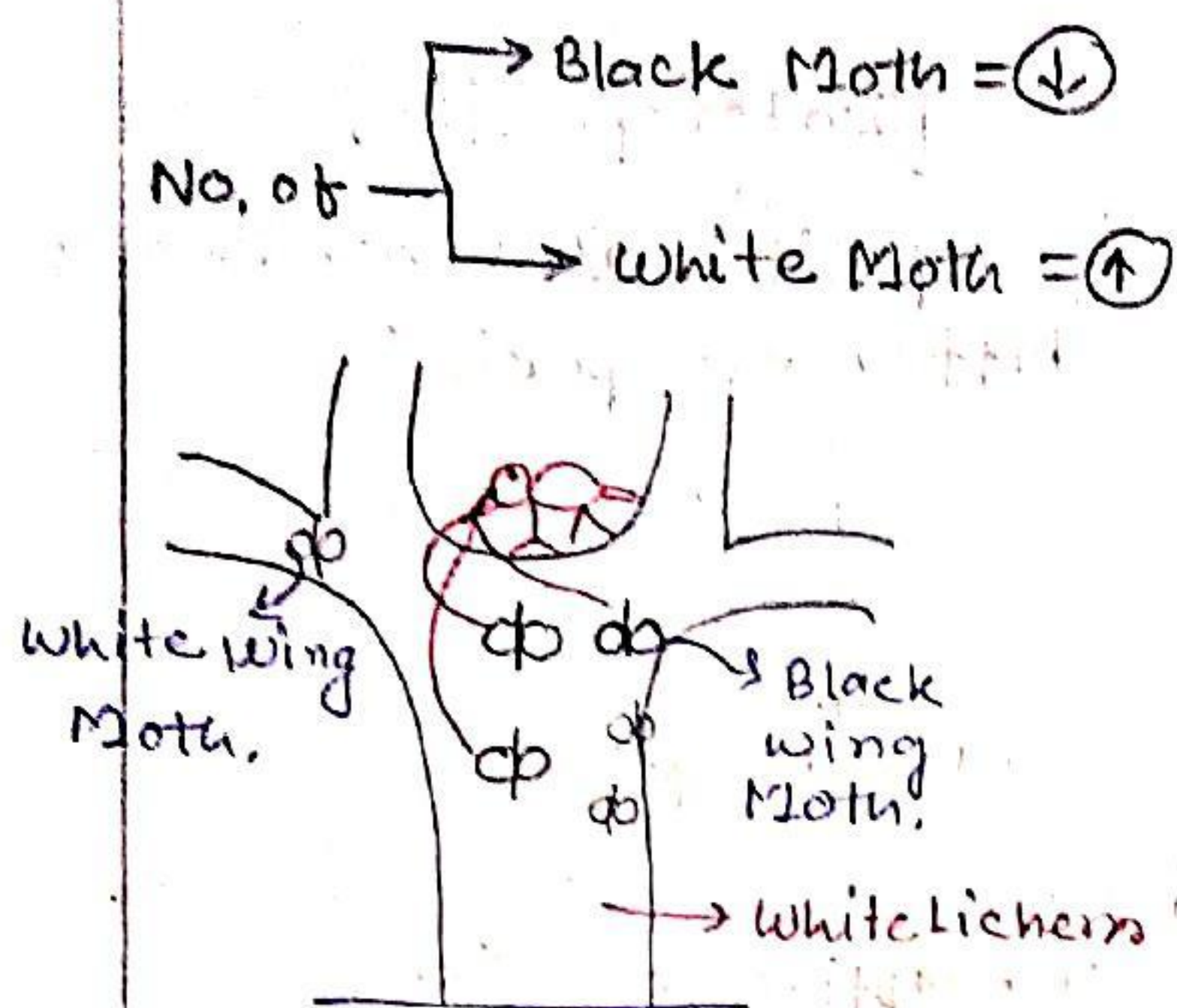
Other theories of Darwin

- Theory of Artificial Selection
- Theory of sexual selection
- ✗ Theory of Pangenesis ✗

↓
Rejected by = Weismann's theory of Germplasm.

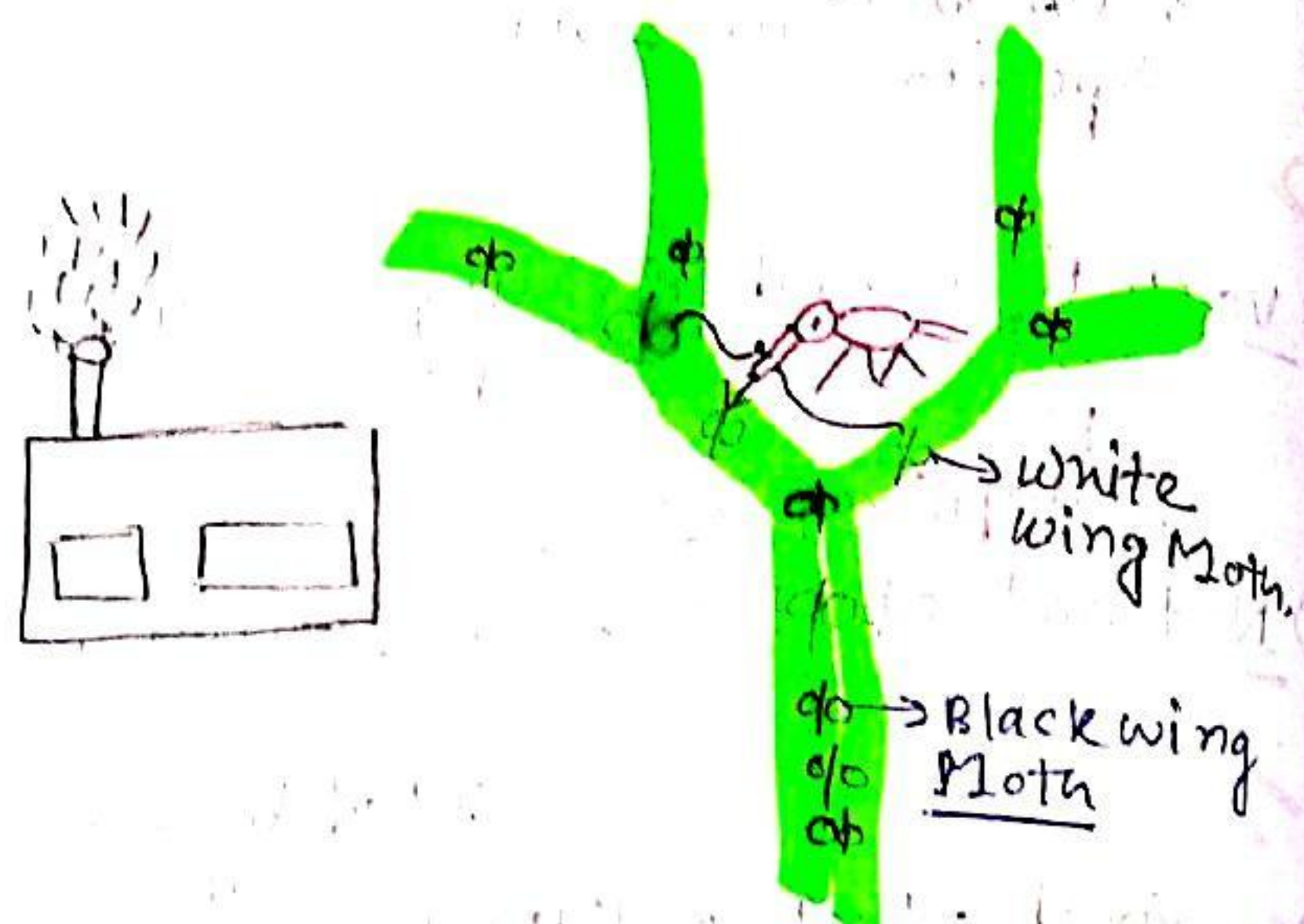
Industrial Melanism (Peppered Moth - *Biston betularia*) [England]

Before Industrialisation [1850]



[1920] After Industrialisation

Black Moth = (↑)
White Moth = (↓)



(3) Mutation Theory :-

→ Hugo de vries → work on → Evening Primrose (*Oenothera lamarckiana*)

→ According to this theory →

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

Darwin

- Variation → small, continuous, Directional, Adaptive
- Evolution → slow + Gradual.

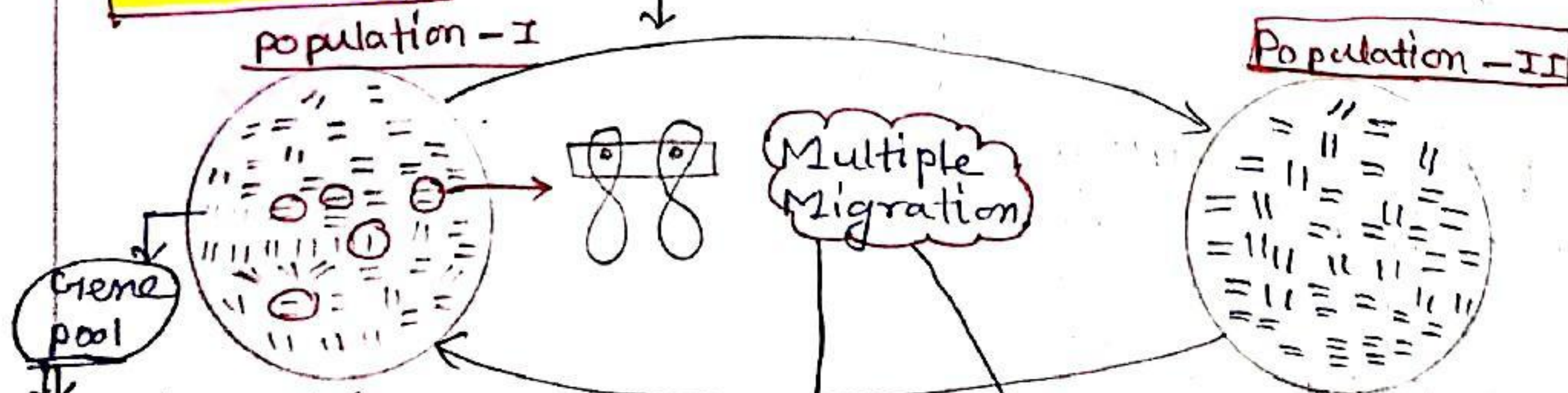
Hugo de vries

- Variation → Large, Discontinuous, Non directional, Random.
- Evolution → Sudden + Jerky process, called → salutation / single step large Mutation

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.

Gene Flow



It is a total collection of all gene and its allele in a population.

change in Gene pool

Responsible for formation of New Species.

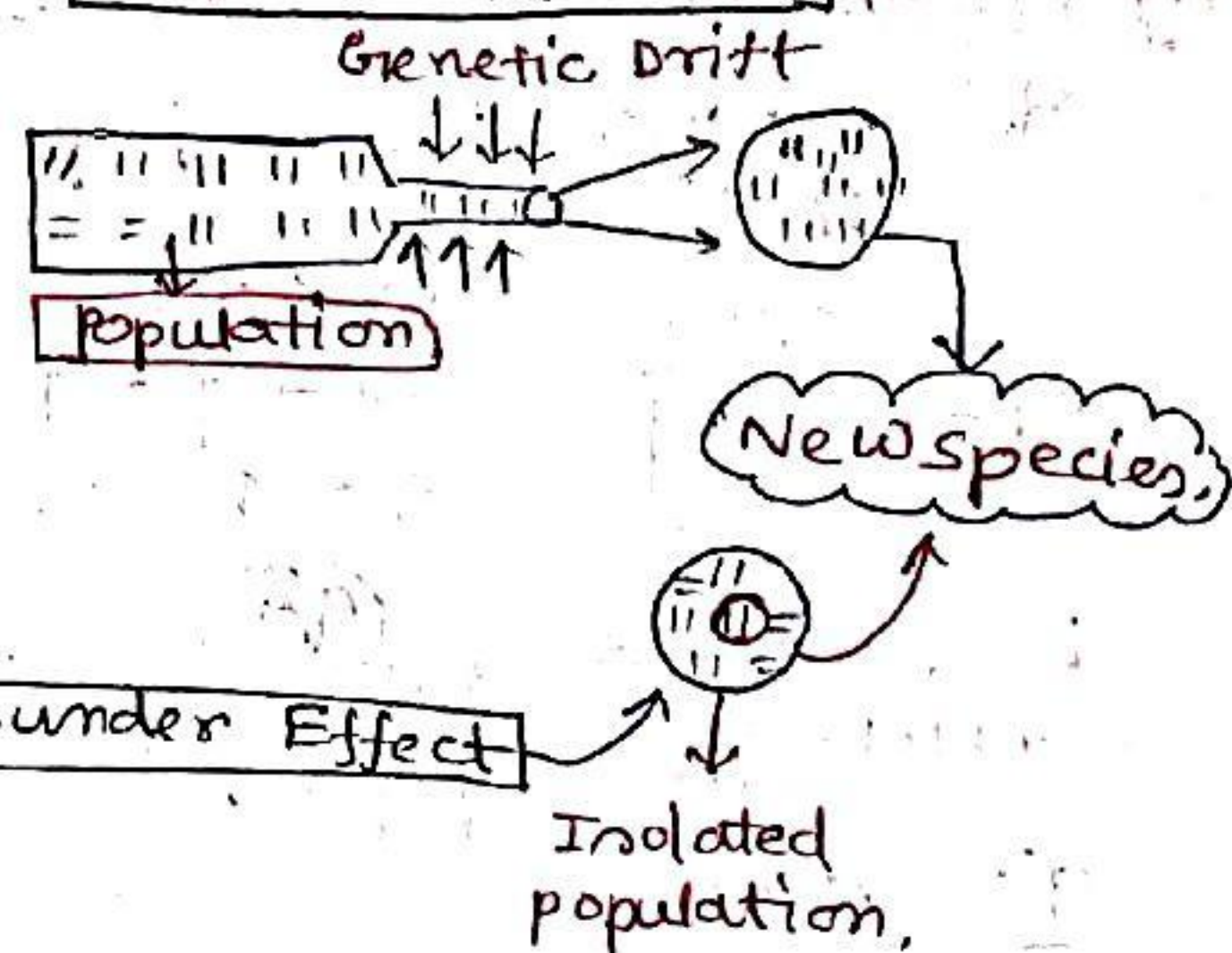
Genetic Drift

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

- Population size may be $\rightarrow \uparrow$ or $\downarrow$ due to
 - $\rightarrow$ Geographical Isolation.
 - $\rightarrow$ Migration by chance.
 - $\rightarrow$ Natural calamity

V.V.I
Small population

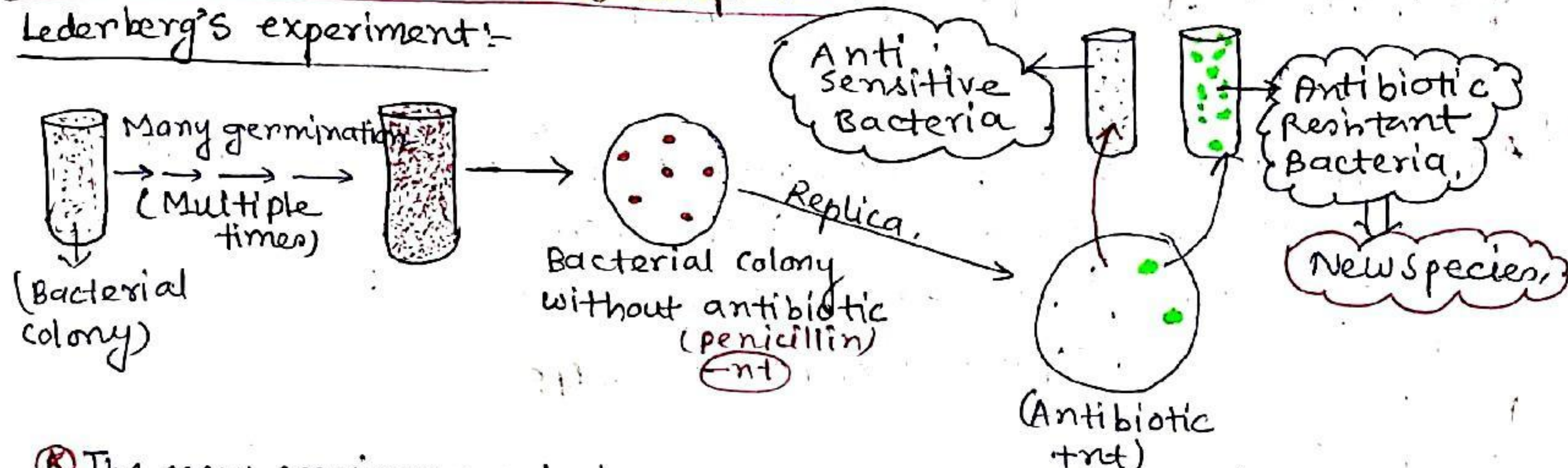
Bottle Neck Effect



Founder Effect

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 occurred earlier.
- ⊗ over few generation, this would result in speciation.

Natural selection

- Stabilising
- Directional
- Disruptive

Reproductive Isolation

Lec 08

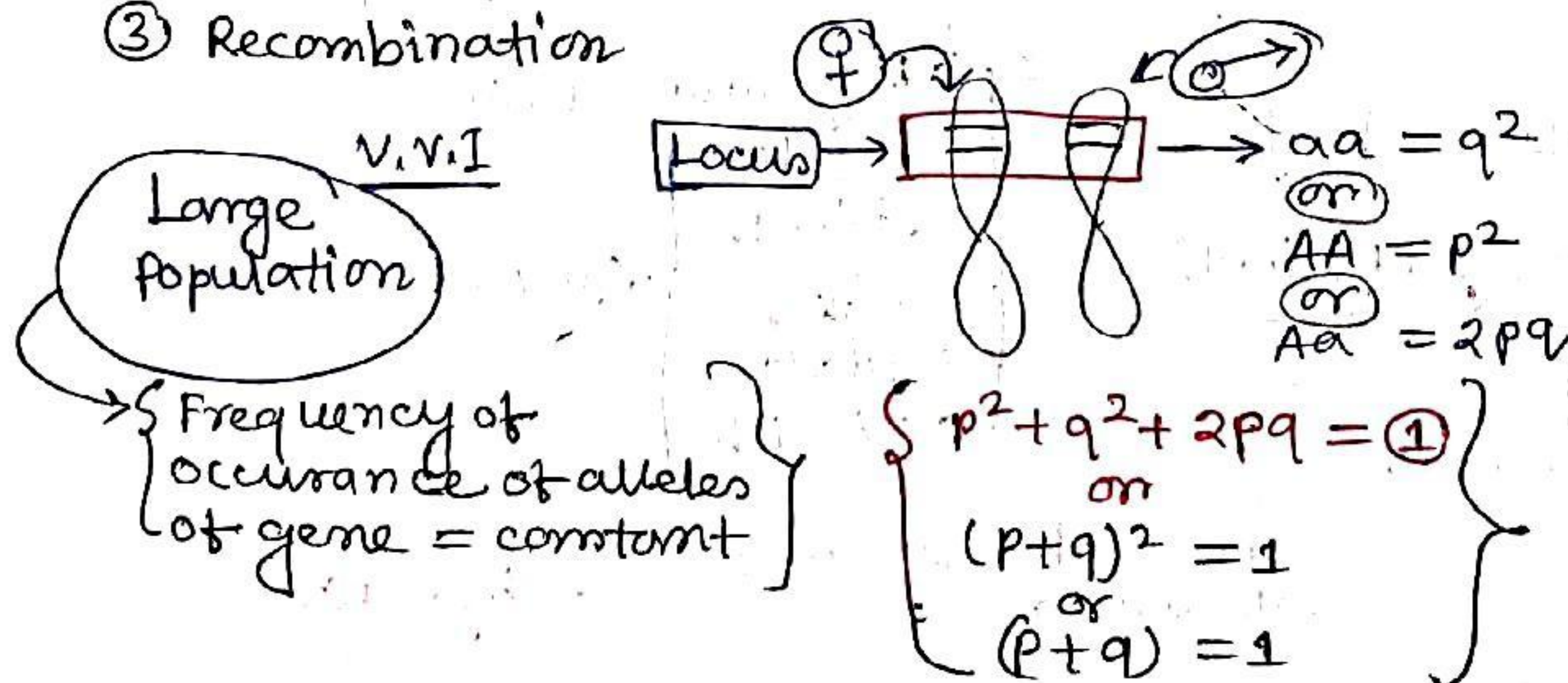
Hardy - Weinberg Principle

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

if $\rightarrow$ Mating occurs at random

$\rightarrow$ Absence of above 5-factors $\rightarrow$

- Mutation
- Genetic drift
- Recombination
- Gene migration
- Natural selection



Q) Frequency of an autosomal lethal gene is 0.4. the frequency of carrier in a population of 200 individual is -

$$\left. \begin{aligned} p &= 0.4 \\ 2pq &=? \end{aligned} \right\} \begin{aligned} p+q &= 1 \\ 0.4+q &= 1 \\ q &= 1-0.4 = 0.6 \end{aligned}$$

$$2pq = 2 \times 0.4 \times 0.6 = 0.48 \text{ (100 individuals)}$$

 for 200 individual = $2 \times 0.48 = 0.96$

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

$$q^2 = 0.16$$

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

$$\left. \begin{aligned} p+q &= 1 \\ p &= 0.6 \end{aligned} \right\} 0.6 \times 100 = 60\%$$

Q) A particular 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 = ?

$$2pq = 2 \times 0.6 \times 0.4 = 0.48$$

BRIEF ACCOUNT OF EVOLUTION

- 1st Acellular Life = 3 BYA
- 1st cellular life (Prokaryotes) = 28 BYA
- Invertebrate become active = 500 M.Y.A
- 1st - vertebrate (Jawless fish) = 350 M.Y.A
- 1st - Jawed Vertebrate = 350 M.Y.A

Eg → Latimeria / coelacanth / Lobefin fish

- caught in South Africa (1938)
- Living fossil
- Thought to be extinct

1st Amphibia = Extinct

1st - Amphibia

Invaded Land after Plant.

[Frogs and salamander]

Early Reptiles (Extinct)

Birds Mammals

- Dinosaurs (Extinct)
- Turtles
- Lizards
- Snakes
- Tortoise
- Crocodiles

Survived.

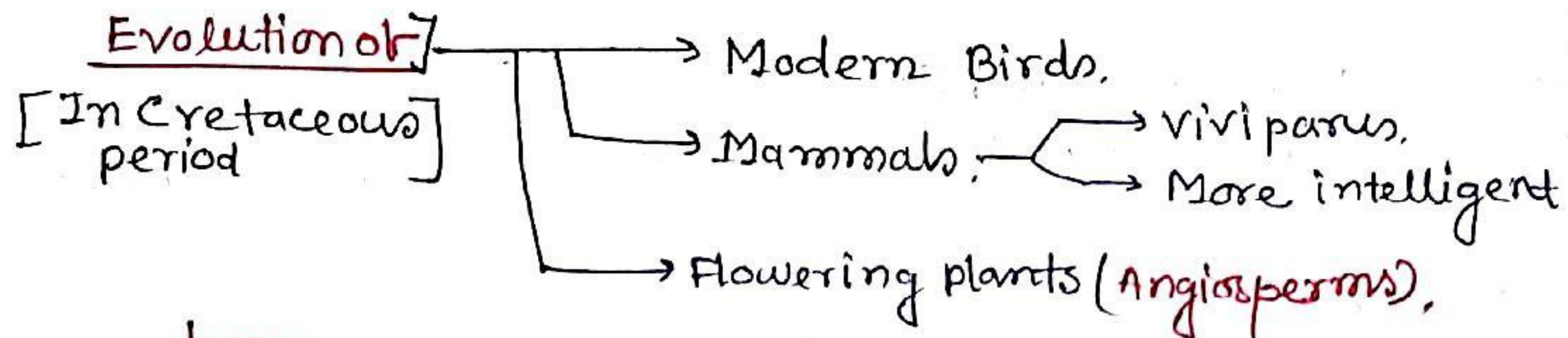
some back into water (200 mya) = Ichthyosaurs.

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

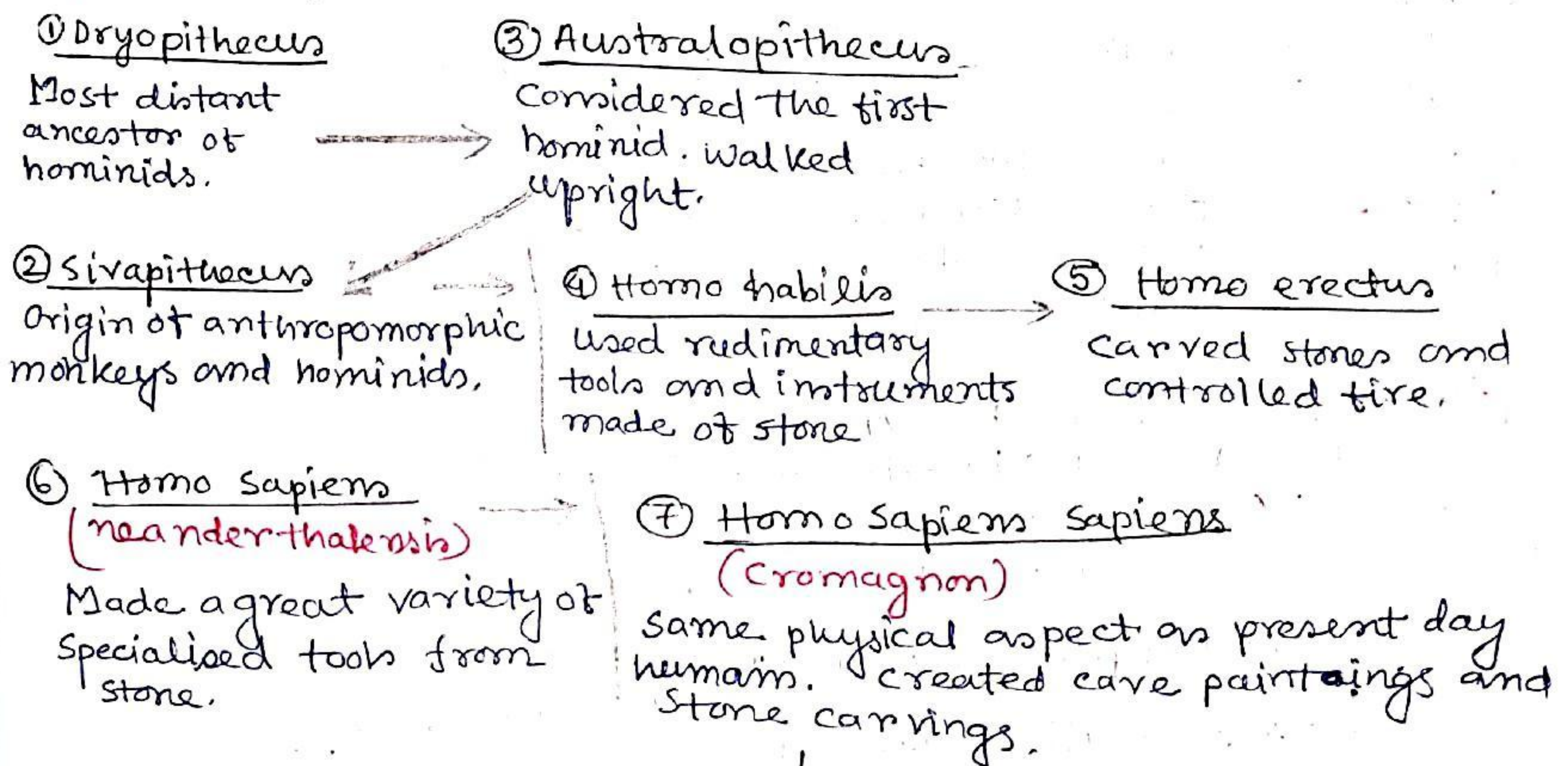
Biggest Dinosaur was →

Tyrannosaurus rex (height = 20 feet)

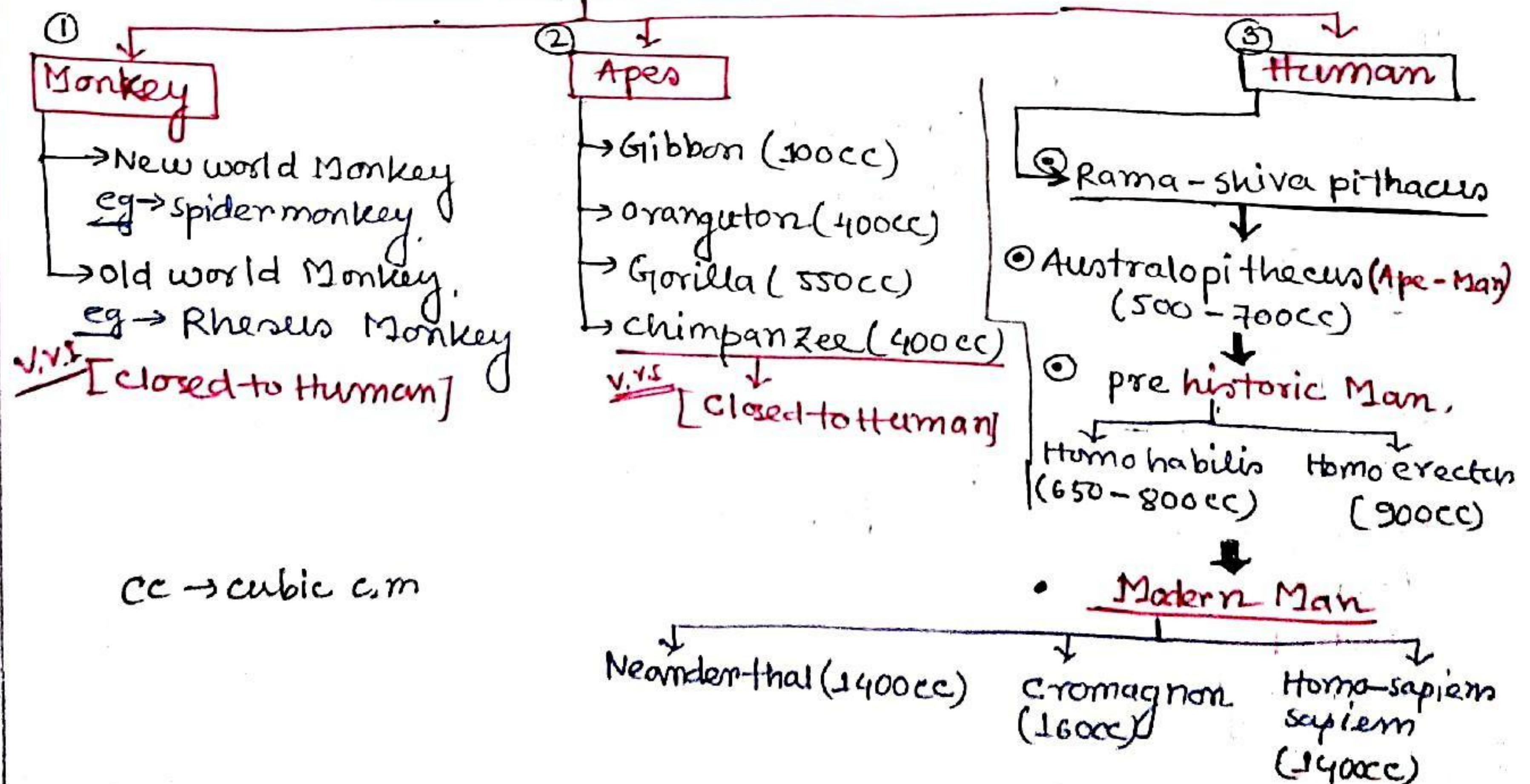
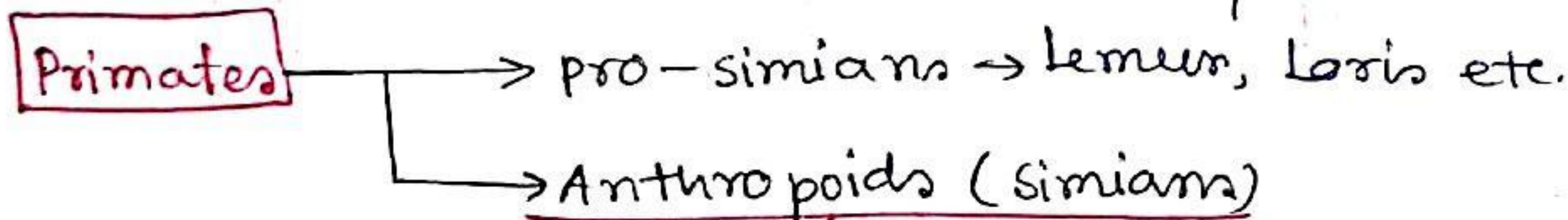
About = (65 mya) dinosaurs suddenly disappeared from earth.
(In Cretaceous period)



ORIGIN AND EVOLUTION OF HUMAN



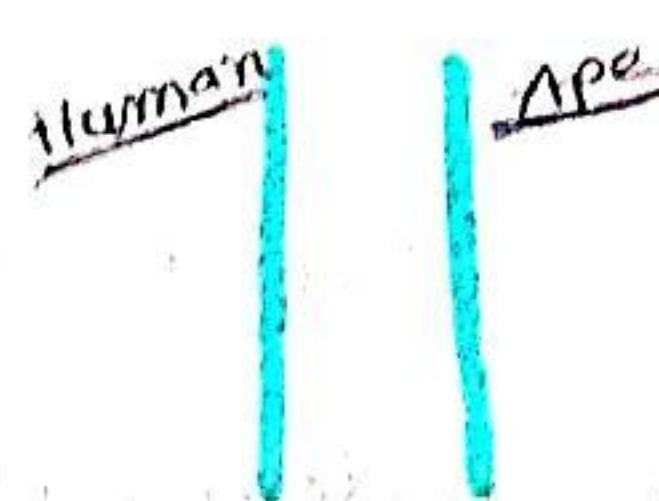
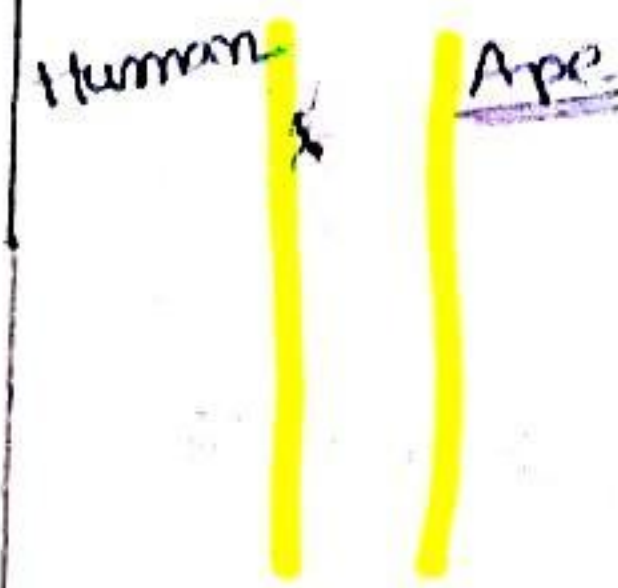
↓
⑧ Homo Sapiens



Chromosomal similarity b/w Human & chimpanzee

chromosome - 3

chromosome - 6



• No. of chromosome

→ Ape = 48

→ Human = 46

DNA content 100% same

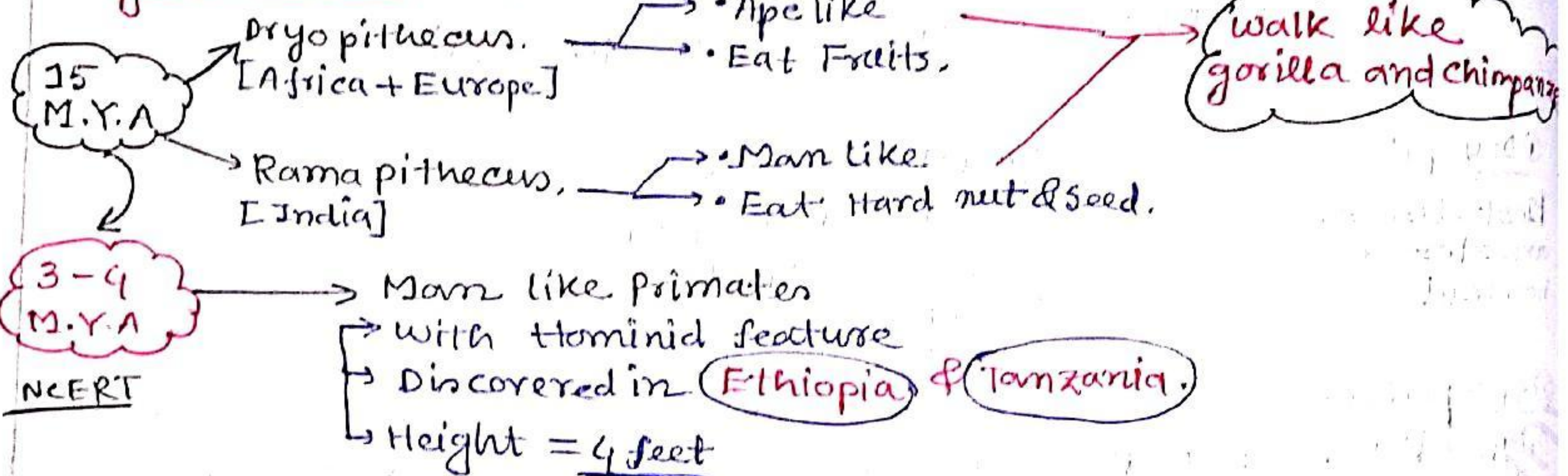
• Banding pattern of chromosome → 3 & 6 of Human and chimpanzee = 100% similar.

Note:-

According to Mitochondrial DNA

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

Origin of man →



Australopithecus

[500 - 700 cc]
(2 - 5 MYA)

- 1st - Ape man
- 1st - Hominid - 1st - Bipedal Locomotion
- 1st - Erect Man
- Lived in = East Africa

- Australopithecus Africanus → African apeman
- Australopithecus Afarensis → Tuang baby

Lucy

skull of 4-6 Y Baby

• Hunted with stone weapons → For Protection

• Eat = Fruits

Pre-Historic Man,

① Homo habilis

(2 M.Y.A)
(East Africa)

- Skill-tall man / Tool maker / Handy Man
- 650 - 800 cc.
- 1st - Human being like
- Probably not eat meat

② Homo erectus

(1.5 M.Y.A)

• Java-man (Indonesia)

• Peking-man (Beijing)

• Heidelberg (Germany)

- 900 cc
- carnivorous
- 1st - Man used fire for hunting, protection and cooking
- Complete erect

Modern Man →

