

25/04/18

Evolution

* Universe → 10 Billion yr. ago

* Earth → 4.5 B Years ago

* Life Originated → 4 B Years ago.

Condition on earth at the time of Origin of life :-

(i) High Temperature.

(ii) Gases → CH_4 , NH_3 , H_2 , He (H_2O Vapours)

* Normal O_2 absent

∴ Reducing atmosphere.

(iii) Fe, Ni → Core of the earth.

(iv) U.V. rays → favoured photo-chemical rxn.

Theories of origin of life :-

(i) Special Creation :-

* Bible → Genesis

1st Man → Adam

1st woman → Eve

* Hindu Mythology

→ Brahma → creator

1st Man → Manu

1st woman → Shradha.

(ii) Abiogenesis :-

By Von Helmont.

* By hair of tail of white horse
→ Gordius.

* By mud of Nile → organism originated.

(ii) Biogenesis :->

-> life exist from pre-existing life forms.

Exp. to support :->

① Francisco Redi

-> Flesh -> cooked



② Spallanzani

-> similar exp. as above in Hay infusion.

③ Pasteur

-> "swan neck" experiment



(iv) Panspermia Theory or Extraterrestrial :->



Chemogenetic Theory or Modern Theory of evolution :->

-> Comprises of three steps :->

① Chemogeny

② Biogeny

③ Cogeneny.

1. Chemogeny or Chemical evolution :->

→ Proposed by oparin & Haldane.

* High temp.

* energy $\begin{cases} \rightarrow \text{UV Rays.} \\ \rightarrow \text{lightning.} \end{cases}$

* Broth Formation.

* gases $\rightarrow \text{NH}_3, \text{CH}_4, \text{CO}_2, \text{H}_2, \text{He}$ (H₂O vapours)

* Atmosphere reducing (no O₂).

→ Simple Chemical Compounds formed like $\begin{cases} \rightarrow \text{sugars} \\ \rightarrow \text{aldehydes} \\ \rightarrow \text{Purines \& Pyrimidines} \\ \rightarrow \text{F.A.} \end{cases}$

2. Biogeny or Biomolecules formation :->

→ Complex Biomolecules formed

DNA \rightarrow RNA \rightarrow Proteins.

Central Dogma.

3. Cogeneny :->

→ 1st life form, formation & its evolution

Proteins + Broth \rightarrow Aggregates

* Protobionts

did not reproduce

* Eiobionts = Coacervates

reproduced.

Note! →

Coacervates → (evolution) ↓

→ chemoheterotrophs.

→ chemophototrophs.

→ anaerobic chemoautotrophs

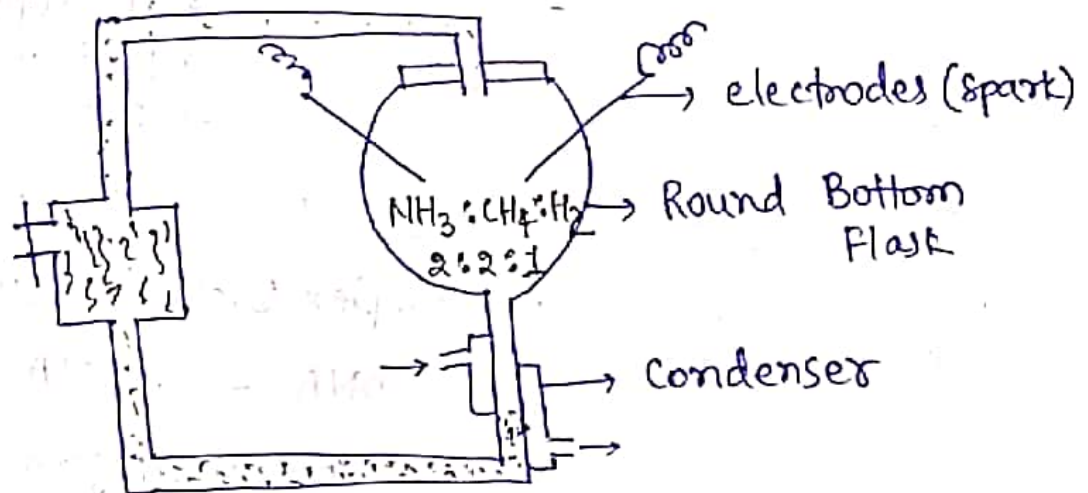
P.S → anoxygenic.

→ aerobic → O_2 in atmospheric

(1st aerobic → BGA)

Urey-Miller Experiment →

→ Experimental proof of chemogenetic theory was given by Urey & Miller.



→ Experiment was performed for 7 days.

→ Gases $NH_3 : CH_4 : H_2$

2 : 2 : 1

→ Temperature → $100^\circ C$.

→ In the sample

glycine, Glutamic Acid,
Aspartic Acid, Purines &
Pyrimidines & aldehyde
were found.

Evidences of Evolution :->

1. Morphological & Anatomical evidences.
2. Embryological evidences.
2. Palaeontological evidences.
4. Biogeographical evidences.
5. Physiological & Biochemical evidences.

① Morphological & Anatomical evidences :->

(a) Homologous Organ :->

→ Have same structure & origin but may perform diff. functions.

Ex! →

1. Hands of Man & forelimbs of Horse.
2. " " " & Flippers of whale.
3. Heart of vertebrates.
4. Thorns of Bougainvillea & tendrils of Passiflora (Passion Flower) & tendrils of cucurbita.
5. Phylloclad (stem) & stem of any plant of opuntia p.s.

↓
does not show P.S.

(b) Analogous Organ :->

→ Different structure & origin but perform the same function.

1. wings of Birds & Insects.
2. Eyes of Cephalopods & Man
3. Phylloclad (stem) of & leaves of opuntia

(c) vestigial Organ :->

-> No longer in Use.

-> weideshem listed such too vestigial organs.

* Nictitating Membrane.

* Appendix.

* wisdom teeth.

* Auricular Muscles (Pinna)

* ♂ mammary glands are reduced.

* ♀ Clitoris is vestigial.

Other Mammals :->

* In flightless birds, wings are vestigial.

* In python -> femur & pelvic girdle are vestigial.

* In Horses -> Splint Bones.

(d) Atavism or Reversion :->

-> If some ancestral characters are present.

Ex! :->

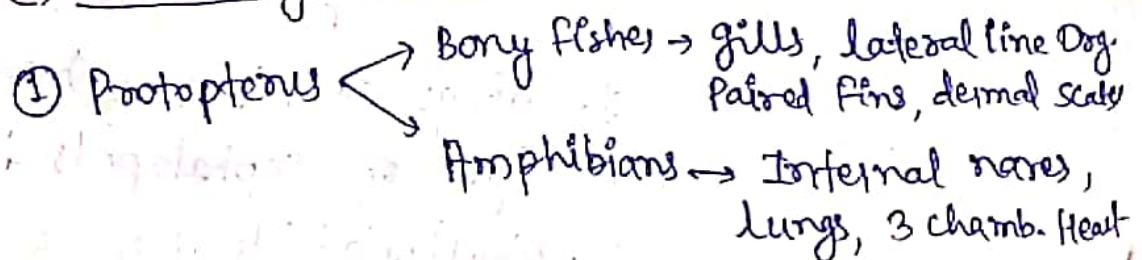
Tail in new born.

Functional Auricular muscles (movement in Pinna).

"Lion Boy" -> Fur on Body.

(e) Connecting Links :->

eg ->



② Ornithorhynchus (duck billed platypus)

↓
Tachyglossus (spiny ant eater)

↙
Mammals

(Hair, diaphragm,
& Mammary glands)

↘
Reptiles

oviparous, polyecithal,
Cloaca

③ Sphenodon ↗ Amphibians
↘ Reptiles.

④ Balanoglossus ↗ Chordates
↘ Non-Chordates.

⑤ Chimera (Rabbit fish)

↙
Bony

↘
Cartilagenous.

② Embryological Evidences :-

→ Early development in triploblastic organism is similar.

(Platyhelminthes → Mammals)

Zygote → Blastulation → Gastrulation
↓
3 germ layers

→ Early embryonic development in vertebrates
Tail, gill slits, eyes & ear buds.

→ Temporary embryonic structure

Egg Tooth → Birds ⇒ Birds are called
"glorified reptiles"

→ "RECAPITULATION THEORY"

→ By von Baer

→ general structure develops earlier than the special structure.

In the light of evolution, Recapitulation th. was modified as Biogenetic Law.

General Str.

↳ Brain, spinal cord
axial skeleton,
aortic arches

Special structure

↓
feathers → Birds
Hair → Mammals

Biogenetic Law

→ By Ernest Haeckel.

"Ontogeny Repeats Phylogeny"

(own development)

(ancestral development)

→ An organism during its own development goes through ancestral development.

Organ dev.

Heart 2ch. → 3ch. → 4ch. (Birds & Mammals)

Brain &
Kidney

③ Palaeontological evidences :->

→ Based on the study of fossils.

↓
remains of organism which existed long time ago.

→ Father of Palaeontology
Leonard da Vinci.

→ G. Cuvier → Father of modern Palaeontology.

→ Age of fossils are determined by Carbon dating

→ Technique by Libby.

(a) Missing Links :-

↳ organisms which are extinct.

• Archeopteryx → Reptilian → Teeth, claws, free caudal vertebrae
→ Aves → Beak, wings, 3 fingers, 4 toes, scapula, sternum keeled.

• Pteridosperm → Ferns
→ Gymnosperms (seed, sec. growth)

• Velociraptors → Birds (wish bone)
→ Reptiles

(b) Soil layers :-

→ different stratas of soil helps us to understand time of evolution.

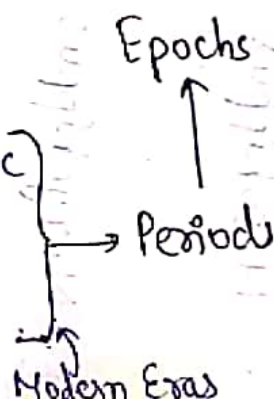
(c) Phylogenetic lineage Horse :-

Before this, we'll study time-scales.

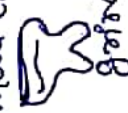

Geological Timescale :-

→ History of Earth is designed by dividing it into 6 Eras, then Periods, then epochs.

- 1) Azoic
- 2) Archeozoic
- 3) Proterozoic
- 4) ~~Mesozoic~~ Palaeozoic
- 5) Mesozoic
- 6) Cenozoic



Phylogenetic lineage of Horse: → (Palaeontological Evidences)

Sc. Names	Common Name	Epoch	Age	Ht.	Fingers	Toes	Molars & Small Canines
1. Eohippus	Dawn Horse	Eocene	60 My	28 cm	4 1st → splint	3 1st & 5th → splint 2, 3, 4 → developed	 Molars & small canines grinding
2. Meshippus	Intermediate Horse	Oligocene	40 my	60 cm + 91ms 1st 2nd 3rd	3 1st & 5th → splint	" "	" "
3. Merychippus	Ruminating Horse	Mesocene	25 my	100 cm	only 3rd was long 2nd & 5th ↓ splint	only 3rd was long 2nd & 4th reduced	long canines  grazing
4. Plihippus	Pliocene Horse	Pliocene	10 my	108 cm	only 3rd long & strong → all other splint	" " 3rd was longest & stronger	" "
5. Equus	Modern Horse	Pleistocene	0.5 my	150 cm	" "	" "	" "

Note! → In modern horses, only one finger of the toes (3rd one) is highly developed, all others are splint.

(d) Biogeographical Evidences :-

(i) Darwin's Finches

↳ small sized black birds.

→ found in Galapagos Island.

→ Ship name was HMS Beagle.

→ Galapagos (22 small islands, west coast of S. America)

Observation :-

→ 20 varieties differed in

1) size

2) Beak shape due to diff. food habits.

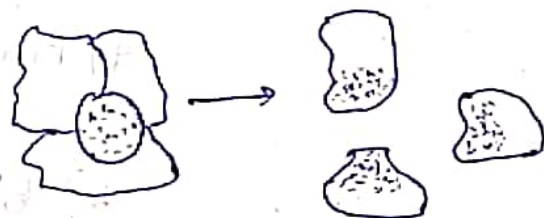
→ Later, Dr. David Lack found that 20 varieties have evolved from 1 grain eating finches.

Note :- Darwin's finches gives us an idea about divergent evolution.



(ii) Discontinuous Distribution :-

1) Elephants are found only in → India & Africa.



2) Magnolia, Tulips & Sassafras found only → china, eastern USA.

3) Lung Fishes

• Neoceratodus → Australia

• Lepidosiren → S. America

• Protopterus → Africa

(iii) Restricted Distribution :->

Marsupials (egg laying mammals) → Australia.

(iv) Convergent evolution :->

Placental Mammals

Marsupials

• Mole

Marsupial Mole

• Mouse

• Mouse

→ when the two different groups when come to lie in the similar kind of habitat and having the same kind of food habit, their body, the structure & feeding habit converges.

(e) Biochemical, Cytological & Physiological evidences :-

1) Enzymes → Amylase & Trypsin are present.
(sponges → Mammals)

2) Hormones → Thyroxine (if it is injected in tadpole → stimulates metamorphosis)

3) cytochrome C

4) Blood & Lymph → in all vertebrates have same function.

5) Blood protein (Haematin crystals)

↳ man → closest to chimpanzee & Gorilla.

↳ similar in cows, goats, sheep

↳ similar in cats, dogs.

6) Blood groups → AB blood group in Humans & Apes (Not in monkeys)

(7) Excretory Substances → Tadpole & fishes
(Ammonotelic)
Frogs → Ureotelic

(8) Similarities in Organelles, protoplasm
in all cells.

Theories of Evolution :->

1. Lamarck's theory of inheritance of acquired characters.
2. Darwin's Theory of Natural selection.
3. Mutation Theory by Hugo de Varies.
4. Modern Theory or Neo-Darwinism
OR Synthetic theory.

1. # Lamarckism :->

→ Theory of inheritance of acquired characters
by Jean Baptise de Lamarck.

Postulates :->

- New needs arises.
- Use & disuse of organs
- Inheritance of Acq. Ch.
- Speciation.

Examples in Support :->

- Giraffee.
- Snakes like Pythons & Boas.
(rudiments of pelvic girdle is found).
- Aquatic Birds.
wings → not used → reduced
feet toes → Used → became webs.
- Flightless Birds.

Note! → Lamarckism is based on the study based on
Comparison b/w fossils & living.

Criticism →

→ August Weismann

"Theory of Continuity of germplasm"

Performed exp. on RATS.

cut ↓ the tail conti... 20 gene
table

The rats were never born with cut
tails.

→ Pavlov's Dog experiment.

Every dog baby was needed to be
trained even though parents were
already trained.

→ wrestler's muscles are very well developed.
It is not necessary that their babies
are also born with muscles very
well dev.

→ Boring of nose & ears.

→ China → small feet of ladies considered
as sign of beauty.

Every generation of child is required
to shape their feet by wearing
wooden shoes.

Note! →

J.B. de Lamarck published all his postulates in
his book "philosophie Zoologique".

2. # Darwin's theory of Natural Selection :->

↳ Inspired by Malthus -> "Essay On Population".

Postulates :->

→ Population increases in geometric progression.
 $2 \times 2 \times 2 \times 2 \times 2 \dots$
32

• Paramoecium Repro. every 20 hrs.

• Bacteria Repro. every 20 min.

→ Food resource & space is limited.

↳ increases in arithmetic progression.
 $2 + 2 + 2 + 2 + 2 \dots$
10

→ Struggle for existence.

1. Intraspecific Struggle

2. Interspecific Struggle

3. Environmental Struggle

→ Variation in a population.

Continuous

• slow

• due to recombination.

Discontinuous

• sudden changes

• Mutation.

→ Natural selection & survival of fittest.

→ Speciation.

3. # Mutation theory of Evolution :->

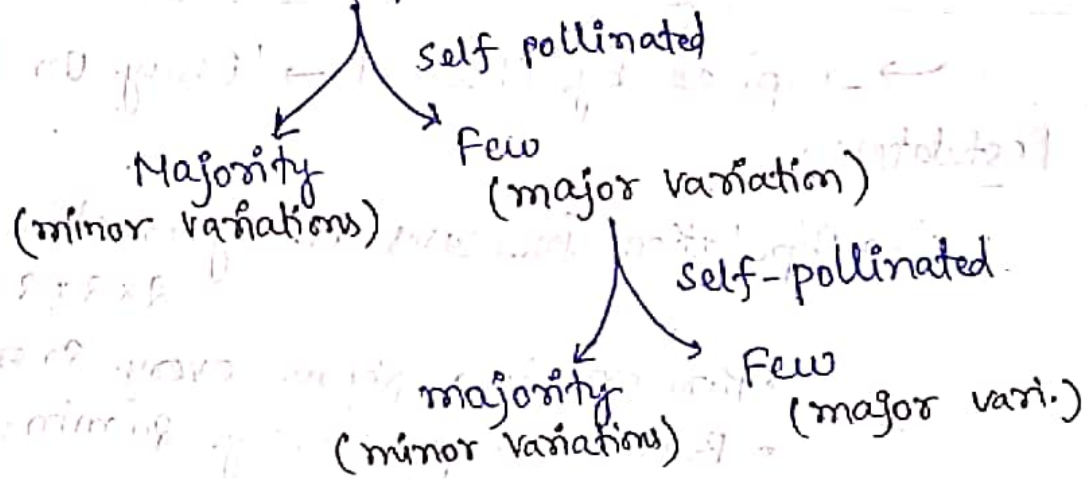
→ By Hugo de Varies.

→ worked on "Evening Primrose"
(*Oenothera lamarckiana*).

↓
normal chromosome no. (2n)

14 sets.

Some plants



→ Variations are in

- Size of flower
- Colour of flower
- due to addn/deletion of chromosome.
- Some mutants had Chr. no. (6, 20, 22, 24, 28, 30).
- These mutants were called as "Oenothera lutea".

Examples in Support: →

→ ~~Acon~~ Ancon sheep → Small legs.

→ Similar exp. by Mac Daegal & skull.
Same result.

→ Common in plants → Polyploidy

May be useful.

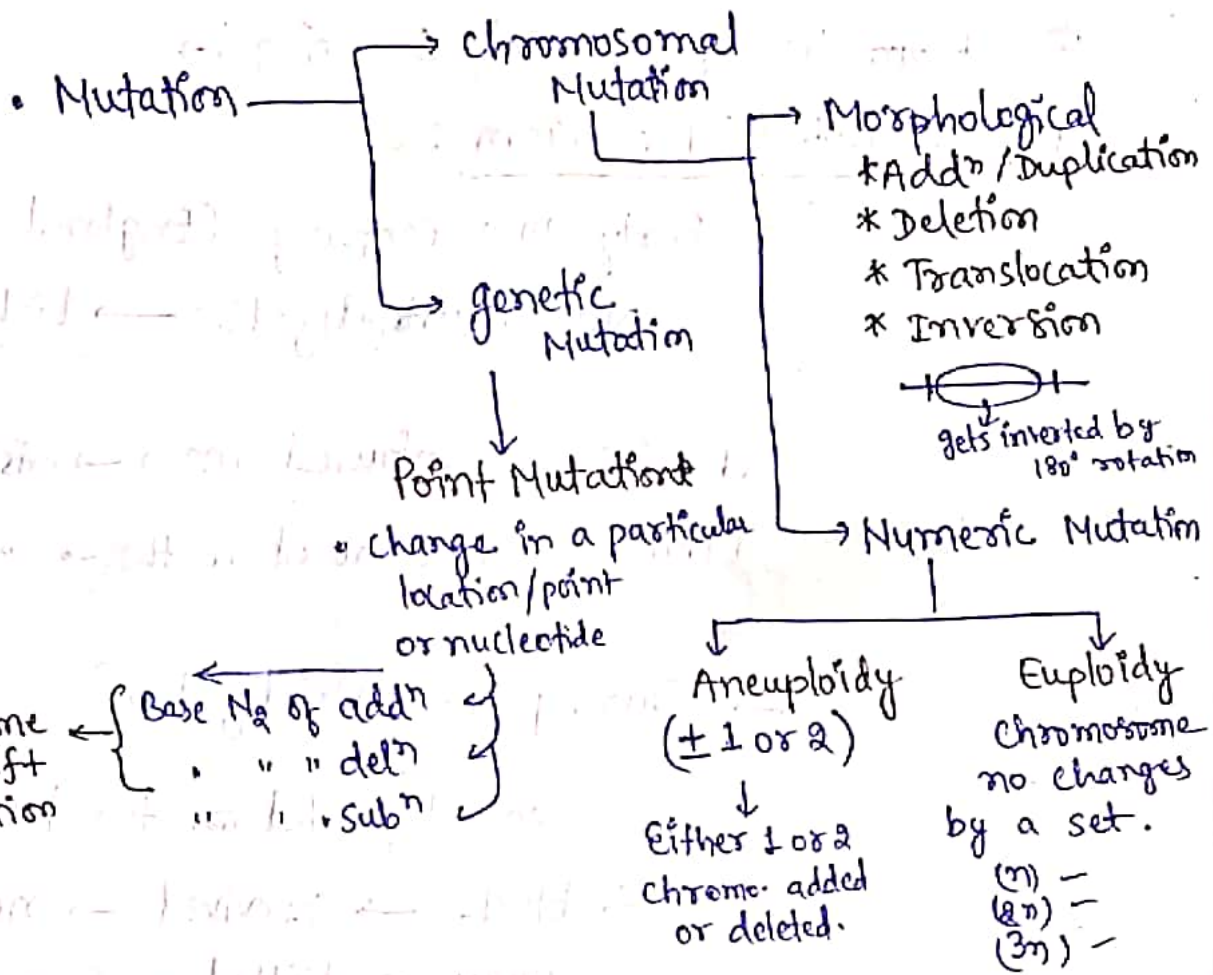
May not be useful.

4. # Neo-Darwinism / Modern Theory or Synthetic theory of evolution: →

1. Gene Variability: →

Causes: →

- Mutation
- Recombination
- Hybridisation
- Genetic Drift.



• Recombination

→ crossing over during meiotic cell divn.

• Hybridization

→ 2 different species are crossed.
→ Hybrid

• Genetic Drift

→ Elimination of genes or alleles from a population.

→ Also known as Allelic Drift

OR
Seivall wright's effect. * (small population)
seen in

② Natural selection :-

→ Nature selects better adapted organism.

→ Better adapted organism will produce more no. of offsprings.

Examples of Natural Selection :->

1. Industrial Melanism :->

-> Early 19th Century (England - Birmingham)

No industrialization -> Lichen grew in plenty.

(plenty) grey coloured moth -> *Biston betularia*

(Few) black coloured moths -> "*carbonaria*"

-> During industrialization

↓
Soot deposited on the bark

∴ black -> survived -> no. ↑.

grey -> killed -> few left.

* loss of light coloured moths due to industrial dev. & then replaced by dark moths.

-> Now, soon industries became electrified

lichen -> grew -> grey
black moths ↓.

Experiments

-> By Bernard Kettlewell.

grey & black -> woods of Birmingham
grey ↑, black ↓.

↳ Polluted area

Black ↑, grey moths ↓.

2. DDT Resistance in Mosquitoes :-

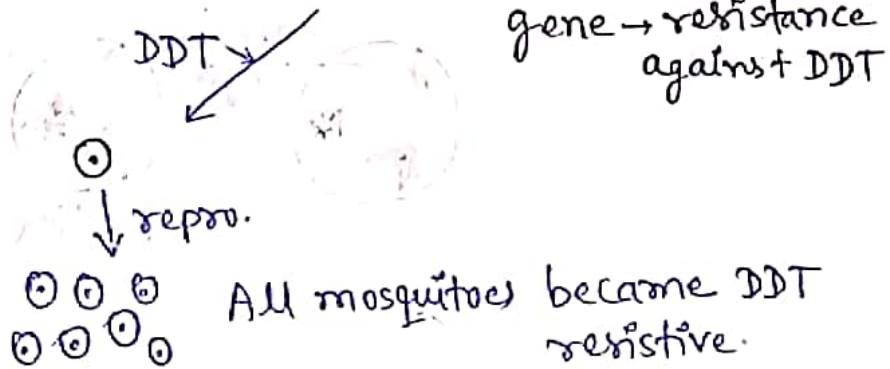
↳ 1940 & introduced

↳ vectors → Plasmodium
wuchereia.

Population of mosquito

⊗ ⊗ ⊗ ⊗ ← Non variation gene
⊙ → variation gene → resistance against DDT

DDT



* Non DDT resistive mosquitoes were killed.

3. Sickle-cell Anaemia :-

→ Autosomal recessive disorder.

* $Hb^A Hb^A$ → normal RBC
" " " " Hb

* $Hb^A Hb^S$ → Resistance to Malaria
 { 50% of RBC is normal
 50% " " " sickle
 50% of Hb normal & 50% defective.

* $Hb^S Hb^S$ → do not survive

→ In Africa, malaria is most problematic.

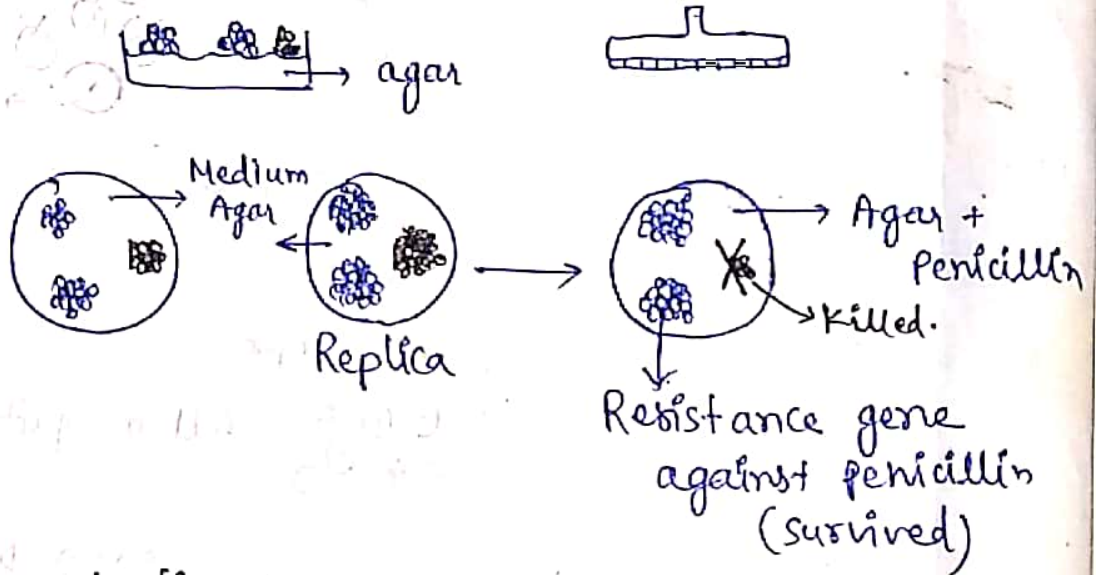
↳ $Hb^A Hb^S$ is resistant to malaria

∴ nature selects this heterozygous condⁿ bcoz it is best suited for African env. condⁿ although the genetic combination is not perfect.

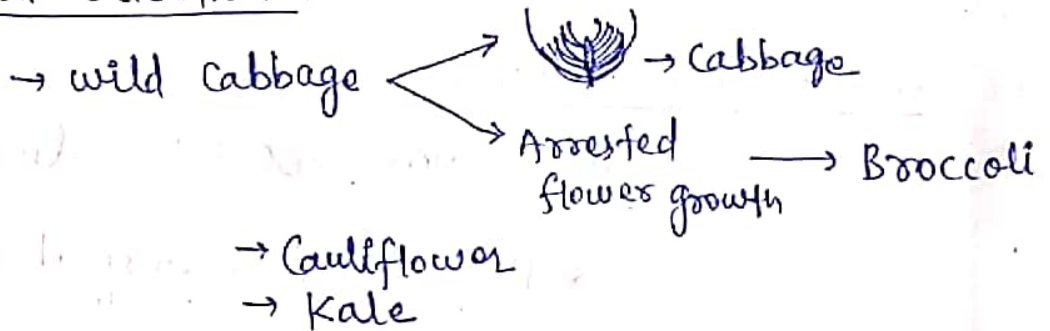
4. Antibiotic resistance in bacteria :->

-> By Joshua Lederberg & Esther Lederberg

"Lederberg Replica plating Experiment"



5. Artificial Selection :->

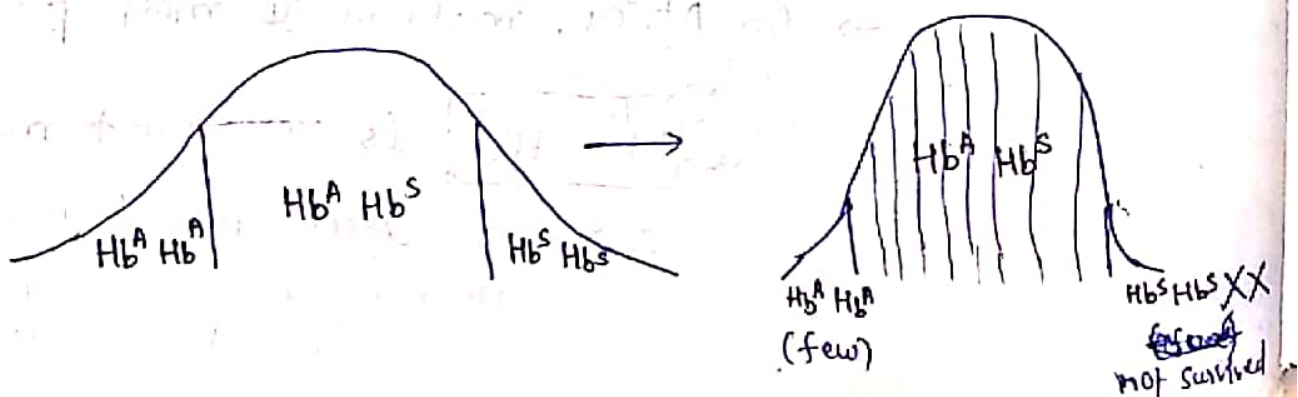


Types of Natural Selection :->

1. Stabilizing / Balancing Nat. Selection :-

- > Intermediate is preferred.
- > elimination of extremes.

Ex: -> sickle cell anaemia $Hb^A Hb^A / Hb^A Hb^S / Hb^S Hb^S$

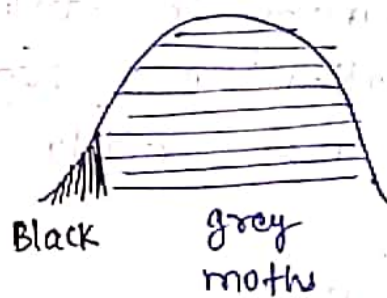


2. Directional / Progressive Nat. Selection :->

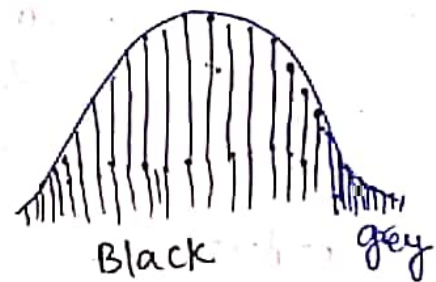
-> Most adapted gene variability is preferred.

Eg -> Industrial Melanism.

DDT resistance in mosquitoes.



Before Indust.



After Industrialisation.

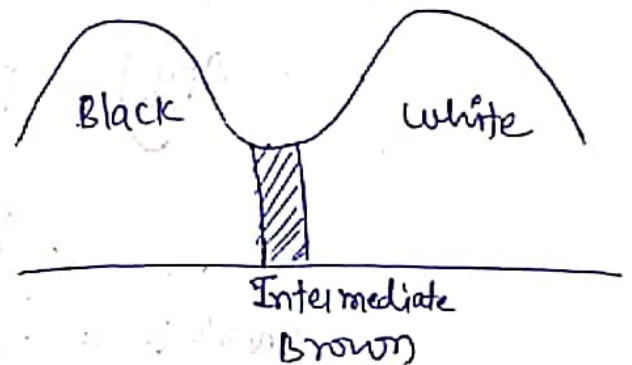
3. Disruptive Nat. Selection :->

-> selects the extremes

-> eliminates the intermediate

Eg -> Snails

→ white bb (sand is white & covered with barnacles)
→ Brown Bb
→ Black BB → (could blend on Black Rocks).



Population Genetics & Hardy Weinberg's Principle :-

→ Pop. Genetics → study of frequency of genes in a population.

HARDY-WEINBERG'S LAW :-

→ Relative frequencies of genes for a population alleles remain constant from generation to generation in a population where organisms are sexually reproducing.

Condns :-
when applicable

1. Big Population
2. Organisms show random mating.
3. No mutation, if mutation takes place they are in both directions.
4. All organisms survive till repro age & have uniform reproductive potential.

$$\left. \begin{array}{l} A = p \\ AA = p^2 \\ a = q \\ aa = q^2 \\ Aa = 2pq \end{array} \right\}$$

AA, aa, Aa ⇒ gene pool

$$p^2 + q^2 + 2pq = 1$$

Hardy-weinberg equilibrium

Factors Affecting :-

1. Mutation
2. Recombination
3. Gene Migration
 - emigration (out)
 - Immigration (In)
4. Genetic Drift
5. Natural selection

Bottleneck experiment



founder Member of Black pebbles.

founder's Effect

Que! → In MN system of blood groups, the frequency of $M = 0.7$ & $N = 0.3$. What would be the frequency of Heterozygous individuals in the population?

Soln! →

$$p = M = 0.7$$

$$q = N = 0.3$$

$$2pq = 2 \times p \times q = 2 \times 0.7 \times 0.3 = 0.42$$

Speciation :->

Speciation

Gradual

Abrupt/Sudden

Allopatric Speciation

Sympatric Speciation

- (1) Mutation
- (2) Hybridization

(a) Raphano Brassica

eg! → Darwin's Finches

Grain eating Black birds

Galapagos Island

→ In different geographical areas.

eg → Pig Frog

Gopher frog

→ Same geographical area.

→ different ecological/ethological niche.

Raphanus sativus ($2n=18$) × Brassica oleracea ($2n=18$)

$n=9$ $n=9$
 $2n(9+9=18)$
 R B

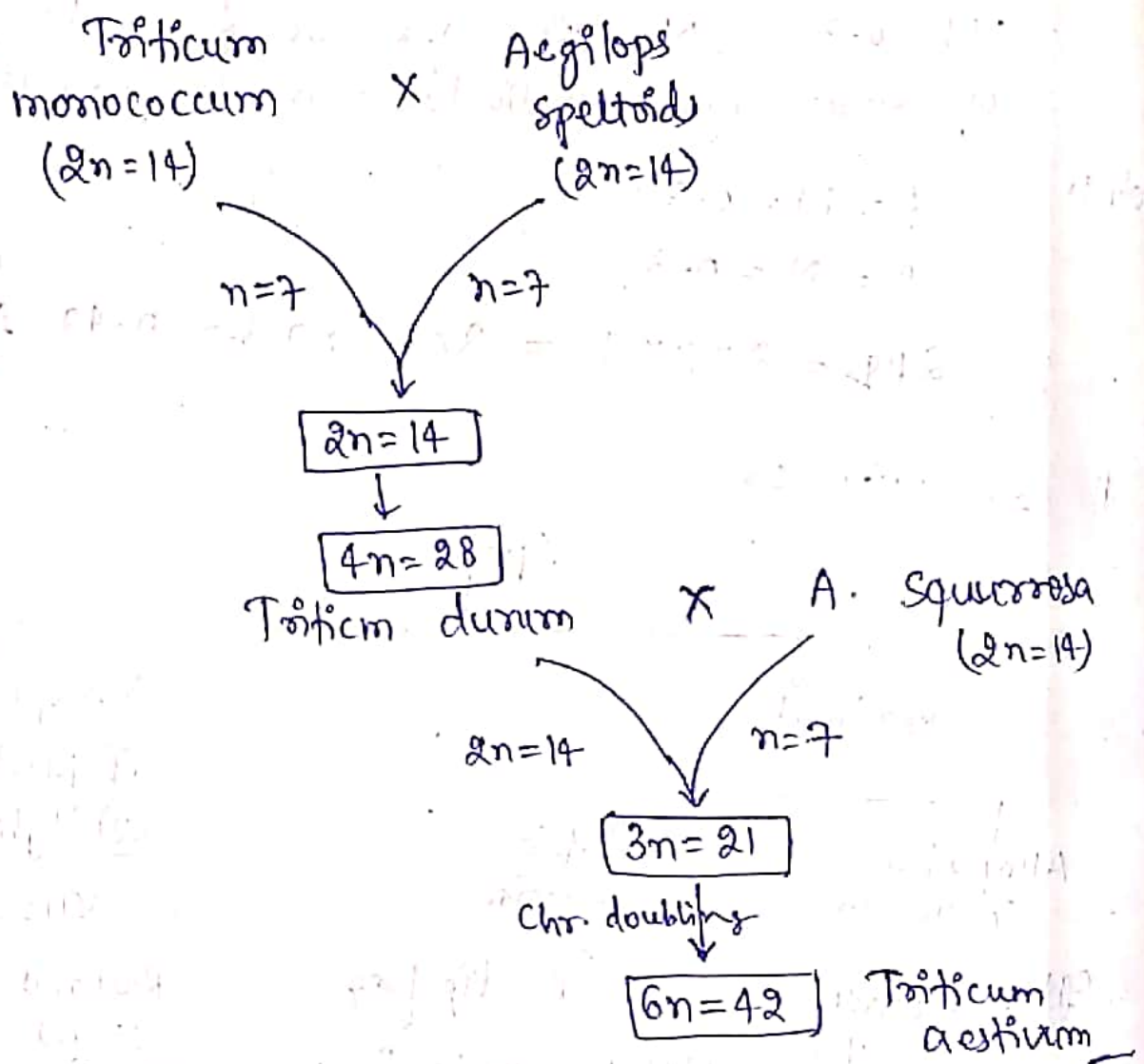
Chr. doubling

$$9+9+9+9 = 18+18 = \boxed{36}$$

4n

Raphanus Brassica

Another example of hybridization is :-



Role of Reproductive Isolation In speciation :-

1. It maintains distinctive character.
2. It results in accumulation of variation.

(A) Pre-mating repro. Isolation :-

- (i) geographical barriers
- (ii) Seasonal (Photo pd.)
- (iii) Different habitats.
- (iv) Physiological barrier
- (v) Mechanical
- (vi) genetic diff. (chr. incompatibility)
- (vii) Behavioural / ethological.

ⓑ Post-mating repro. Isolation :->

(i) gametic mortality.

(ii) zygotic mortality.

(iii) Hybrid mortality.

(iv) " sterility

Mule -> sterile

Lion x Tigress -> Liger } fertile.

Tiger x lioness -> Tigon }

(v) Hybrid breakdown.

Human Evolution :->

Ⓛ Dryopithecus &

-> Fossils from
Bilaspur (HP).

-> Hairy.

-> More ape like

-> walked like
gorilla.

-> Considered as the common
ancestor of ape & man.
existed 15 MYA.

Ramapithecus

-> Fossils from shivalik
Hills.

-> Erect.

-> Had small canines.

-> More man like.

Ⓜ Australopithecus :-

-> African Ape man (E. Africa). a) A. robustus
b) A. bailey.

-> Fossils discovered by Ramond Dart.

-> used stone weapon, Hunters.

-> Cranial Capacity 600 cc.

-> Ate fruits

-> Bipedial locomotion (man like), had lumbar curve

-> Man like teeth.

③ Homo Habilis :->

- > Fossils discovered by Leaky.
- > didnot eat meat.
- > "HANDY MAN"

④ Homo erectus :->

- > 1.5 MYA.
- > Fossils found in 1891.
- > cranial cavity 900 cc.
- > Ate meat.
- > large supra orbital ridge.

(a) Homo erectus erectus :->

- > "Java ape Man"
- > Fossils from Java island.

(b) Homo erectus pekingsis

- > "Peking Man".
- > Found in China - Peking.
- > Cranial cavity 1075 cc.

⑤ Neanderthal Man :->

- > 1-4 MYA in east & central Asia.
- > Used hides to protect body.
- > Buried the dead.
- > Short stature.
- > Strong mandible.
- > Cranial capacity 1400 cc.

Note :->

Neanderthal Man is considered as

1st Civilized Man.

⑥ Homo Sapiens :->

→ 10-70 K years ago.

→ Africa → rest of the world.

a) H. Sapiens fossilis.

b) H. Sapiens sapiens.

* Homo Sapiens fossilis :->

"Cro-Magnon"

→ Tall.

→ erect.

→ Cranial Cavity 1660 cc.

→ Cave dwellers.

→ Carnivores.

→ Used sophisticated tools.

* Homo sapiens Sapiens :->

"Modern Man"

→ domesticated animals.

→ Agriculture → 10 KYA.

→ divided into 4 ethnic groups :-

a) Negroids → Africa

b) Caucasians → England & Italy.

c) Eastern → Japan, China, Aust, India

d) Mangoloids → Mangolia.