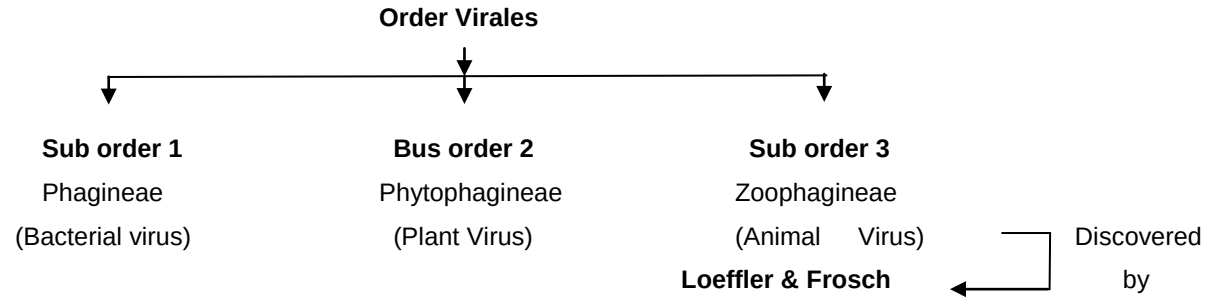
VIRUSES

CLASSIFICATION OF VIRUSES:

1. **Holmes** in 1948 proposed the classification of viruses. He placed all the viruses into a single order **virales.** Which is further divided into three sub orders as under.



2. **Andre L Woff, Robert Horne and Paul tournier** in 1962 proposed a new system of classification of viruses commonly known as **LHT system.** This system of classification is mainly based on nucleic on nucleic acid, symmetry number of capsomeres in a capsid, shape and size of virus etc.

Division	-	Monera
Class	-	Microtetobiotes
Order	-	Virales
Family	-	Deoxy – ribovira (Viruses with DNA)
		Ribovira (Viruses with RNA)

HISTORY

- **Virus : Latin** word, which means **"poison"** or **"venom"** or **"secretion"** (According to **Pasture**).
- The first discovered virus $\rightarrow$ **T.M.V.** = "Tobacco Mosaic virus"
  A disease is caused by this virus on tobacco plant, is called "Mosaic disease of tobacco"
  The fist symptoms appears on the leaves of tobacco.
- **Mayer** described Tobacco mosaic disease and he named **'infected sap disease'.**
- **Ivanowsky** separates a micro organism from the sap of infected plant and named **"TMV"**. He reported that viruses are smaller than bacteria and they can pass through the bacterial proof filters.
- **Davis** called them **Vitamol.**
- **Beijerinck** called them **living fluid infectant** or **Contagium vivum fluidum**. i.e. Living infectious fluid.
- **Stanley** crystallized TMV first time and obtains in the form of nucleoprotein. Nobel prize was awarded to him for this discovery. He said that its **protein** part retain their infectivity.
- **Bawden** and **Pirie** first of all studied the chemical nature of viruses and said that these are nucleoproteins.
- **Gierer** and **Schramn** discovered infecting part of TMV is **RNA.**
- **Franklin** discovered the microscopic structure of TMV.

  Note : (1) Virus : **Akaryota** group (2) Study of virus : **Virology**

CHARACTERISTICS FEATURES OF VIRUSES

1. These are **submicroscopic** & **acellular** organisms generally smaller than 200 mμ /200nm.
2. They **are** obligate intracellular parasites.
3. They have **either** RNA or DNA.
4. They can pass through bacterial filters.
5. **They** have characteristic mode of multiplication, i.e. once a virus enters into the host cell, it takes control of whole biochemical machinery of host cell and directs the metabolic machinery to synthesize their own (viral) components.

Non-living characters of viruses :

1. Absence of protoplasm
2. Absence of enzyme system.
3. No respiration.
4. They can be **crystallized** like chemicals.
5. They do **not** grow in culture medium.
6. They are **inert** out side the host cells.
7. They are autocatalytics and lack functional autonomy.

Living characters of viruses :

1. They contain nucleic acid as a result of which they are capable of synthesizing proteins for their coat, although they use ribosomes of the host for the purpose.
2. They can multiply inside living host cell.
3. They have antigentic properties and shows mutation and specifing to the particular host.

On the basis of above characters in can be said that viruses from a **transitional group** between living and non-living

MORPHLOGY AND STRUCUTREU FO VIRUSES

Size of Viruses :

- TMV - 300 mμ × 20 mμ or 300 × 20 nm
- Smallest virus - **F_2 Bacteriophage**/F_2 - coliphage - 2 nm
- Longest plant virus - Citrus tristeza virus. (200 × 12 nm)
- Longest animals virus - LPT - Lymphogranuloma psittisis tranchoma virus size - 275 mμ or 275 nm
- Smallest animal virus - Foot & mouth virus - 10 nm
- Largest animals virus - Smallpox virus **(Variola virus)** 400nm

SHAPE

Brick shaped - Small pox virus

Spherical - Influenza virus, Myxo, Polio, HIV

Rod shaped - TMV

Tadople like - Bacteriophages

Bullet shaped - Rabies virus

Chemical composition :

Chemical there are two components of viruses

(1) Nucleic acid - core

(2) Protein coat

1. **Nucleic acid :** Either RAN or DNA

Generally in plant viruses, RNA is present but in **Cauliflower mosaic virus** and **Potato leaf roll virus** DNA is present.

Generally in animal viruses, DNA is present but in following animal viruses, RNA is present

(i) **Influenza** virus, Single stranded RNA.

(ii) **Rous sarcoma** virus, Single stranded RNA.

(iii) AIDS virus : Single stranded RNA.

(iv) **Polimyelitis virus :** Single stranded RNA.

(v) **Reovirus :** Double stranded RNA.

- Single stranded RNA viruses (e.g. AIDS virus) which carry few molecules of reverse transcriptase enzyme (which copies RNA into DNA, i.e. reverse transcription), are called **retroviruses.**

  Generally RNA is **single stranded** but in **Reovirus, Wound tumour virus** and **Rice dwarf virus** RNA is **double stranded.**

2. **Protein coat :**

   It is known as **capsid** and made up of structural units called **capsomeres.** (Number size and structure of capsomeres are vary and these capsomeres are arranged in different manners to form different types of symmetry)

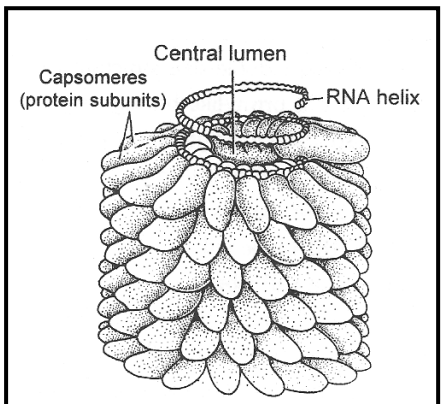
   Central core & capsid and collectively known as **muleocapsid.**

   Note : An additional covering is also present in some viruses around the capids. It is composed of Lipo protein. Such type of viruses are known as **lipovirus.**

   Example : **Myxo Virus** and **Herpes Virus.**

Symmetry of viruses.

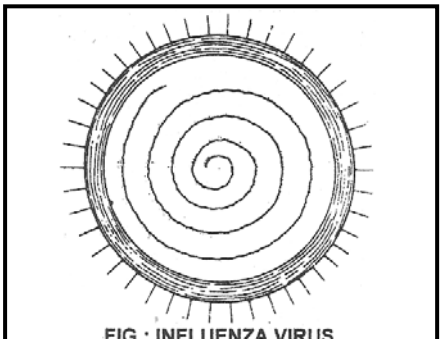
1. **Helical symmetry : Capsomeres are** arragned in helical manner in the capsid, e.g. **TMV Influenza** virus and Mumps virus etc.
2. **Cuboidal symmetry :** Capsomeres are arranged on the surface to form a 20 sided cube, e.g. Turnip Mosaic Virus, Herpes virus, Adeno virus, Polyoma virus, Tipula virus.
3. **Complex symmetry :** T_2 - Bacteriophage & Pox virus.



STRUCTURE OF TOBACCO MOSAIC VIRUS

TMV (Tobacco Mosaic Virus) :

- It is the most throughly studied virus and was discovered by the Russain worker **D. Ivanowsky** (1892).
- It is **rod shaped** virus measuring **300 nm × 20 nm**
- It is having **helical symmetry.**
- Having **single stranded RNA** which is **330 nm** is length and having **7300 nucleotids.**
- In a capsid number of capsomeres are **2130.**
- 5% RNA and 95% protein $\rightarrow$ present in TMV.


FIG : INFLUENZA VIRUS

Influenza virus - Size 80 -120 nm

Spherical virus, infecting respiratory tract.

- Having helical symmetry, 10% RNA and 90% protein
- Having **single stranded RNA,** killed at 65^0C and active at low temperature.
- Crryptogram of influenza virus : R/1 : 2-3/10S/E : V/E

Bacteriophage Virus :

Virus which infecting the bacteria

- Bacteriophage was discovered by **F.W. Twort** and **Felix d' Herelle**
- **Shell Singer** explained that bacteriophage is made up of nucleoprotein (Nucleic Acid + protien)
- **Hershy** and **Chase** discovered heredity material - DNA in **T_2- bacteriophage** through the radio tracer techniques.

Cyanophage : The virus which infects **blue green algae** are known as **cyanophage.** (Discovered by **Safferman** and **Moris**). Cyanophages contain **ds DNA**. The structure of cyanophages is similar to the bacteriophages. (ex Lpp-1 called so as it attacks Lyngbaya, Phormidium and Plectonema)

Sinsheimer : He discovered single stranded DNA in ϕ **× 174** bacteriophage.

NOTE :

- In bacteriophages, generally DNA is present but in **MS_2** F_2 r - 17 bacteriophages **ss RNA** is present.
- Generally **DNA is double stranded** but in ϕ × 174 bacteriophage and in S13. ***E.coli phage,*** DNA is single stranded

Types of bacteriophages :

Broadly of 2 types :

1. **Prophages or non-virulent phages or non-infective phages :** The phages which don't cause lysis of bacteria are called prophages. Such bacterial cells which are having prophages inside them are called **Lysogenic bacteria.**
2. **Virulent phages or infective phages or, Lytic phase :** The phages which cause lysis of bacterial cell are once are called virulent phages.

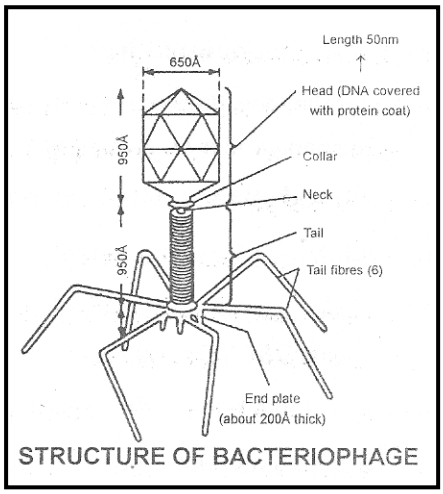
Note :

Most studied series of bacteriophages is T-series, i.e. T_2, T_4, T_6 etc. (T-even phages are characterized by angular head and long contractile tail).

In T_3 and T_7 bacteriophage head is **hexagonal.**

Structure of bacteriophages :

Having tadpole-like structure and differentiated into head & tail. Head is prism like having length 950 Å and breadth 650Å Tail is also 950 Å in length, joined to head by neck and collar. Tail is having hollow core of 80Å and is surrounded by tail sheath. At the end of tail, end plate is present to which 6 tail fibres are attached, each is **1500Å** in length.



STRUCTURE OF BACTERIOPHAGE

Function of tail fibres :

The tail fibres have two main functions : (i) They help in the adsorption of phage particle on the surface of the bacterium (ii) The enzymes secreted by these fibres are helpful in the lysis of bacterial cell wall.

NOTE :

1. **The water of Ganga** is not spoiled due the presence of bacteriophage.
2. The circular area of dead bacteria on agar plate, is called **plaque.**

LIFE CYCLE OF BACTERIOPHASE

The life cycle of bacteriophage is also known as **infection cycle,** which synthesizes many new phage particles thus, also referred as reproduction (or replication). The pages reproduce usually by two means - (i) Lysis (ii) Lysogeny

(i) Lysis / Lytic Ccle :

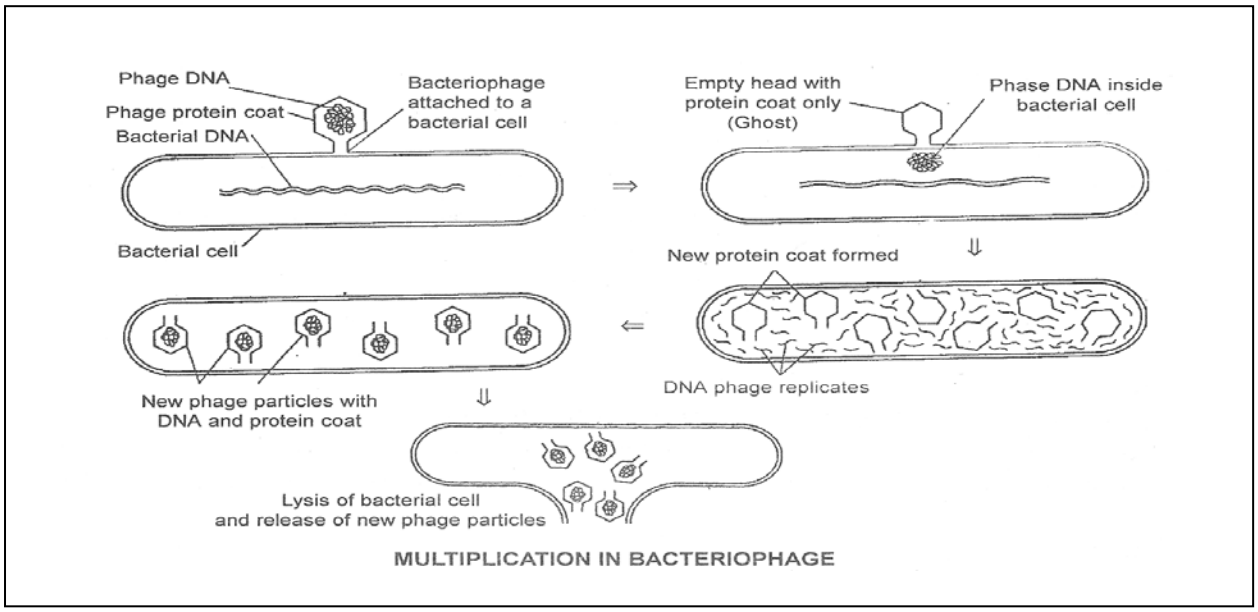
In this process virus gets like enzyme atached to the cell wall of bacteria at a specific place known as receptor site. At these receptor sites, Lysozyme synthesized by viruses react with bacterial cell wall. Consequently, a minute pore is formed through which DNA of the phage enters into the host cell. The empty capsid and tail fibres left behind are called **ghost**. After infection phage DNA assumes control of the cellular metabolism of bacterial cell and directs to synthesize the phage DNA and proteins. Subsequently, these new DNA molecules and protein particles assembled to form new bacteriophages which are liberated in the medium by the endolysis of host cell wall facilitated by the lysozyme like enzyme.

(ii) Lysogeny/Lysogenic cycle :

- The initiator virus of this cycle is known as **temperate phage/ λ - phage**
- The host cell is not degenerating in this cycle. The DNA of bacteriophage joined with the genophore of bacterium after the infection and replicates along with this. In this condition it is transmitted to progeny of bacteria. Such a virus called as **provirus** or **Prophage.** Bacteria which carry a provirus are called lysogenic bacteria and virus whose chromosomes becomes prophage are called lysogenic viruses.
- If, it separates from the genophore artificially then it becomes virulent and start the Lytic cycle.

NOTE :

1. It possible to induce lysogenic bacteria to lysis by irradiation with ultraviolet light or by exposure to some chemical like H_2O_2
2. Due to show reproductive process sometimes, millions of viruses can live their hosts for long period without any apparent indication of their presence. These are called **latent** or **inapparent infections.** [Multiplication of viral DNA takes place in the latent phage of virus]



MULTIPLICATION IN BACTERIOPHAGE

Transduction : When transfer of genetic material from one bacterium (Donor cell) to another bacterium (receptor cell) takes place by bacteriophage, called as **transduction.**

Discovered by **- Zinder & Lederberg** 1952) **in Salmonella typhimurium.**

Type of tansduction :

1. **Generalised transduction :** In this type of process bacteriophages are capable to transform any gene of bacteria.
2. **Specialized transduction :** In this type of process bacteriophages are capable to transform special part of donor genome.

APPLICATIONS OF PHASE PARTICLES

1. Phages are used in the diognosis of certain infections.
2. In space microbiology lysogenic cultures are used as radiation detector. They were used by Russians in the space ship, **Vostok-2**
3. Phages are also helpful in the lysis of bacteria present in the polluted water. Hence, they can also be used as scavengers.

4. Temperate phages help in transduction of genetic material from on bacterial cell to another. They are also used widely as models in genetic research.
5. Phages are often very harmful as they kill beneficial micro organisms by the Lysigenic activity during process of munufacture of antibiotis and milk products.

Mycophages :

- Viruses, infecting fungi are called mycophages.
- Mycophages were first of all discovered by **Sinden** (1957) in **Agaricus bisporus.** These are having **double stranded RNA** and are **spherical** or **polyhedral** in shape.

Viroids

- **T.O. Diener** (1971) discovered some new infectious agents, which are still smaller than viruses. These **subviral infectious agents** are called **viroids.**
- Viroids contain only verylow mol. wt. RNA (ss RNA) and not protein coat.
- **Viroids cause Potato spindle tuber disease** (PSTV), **Chrysanthemum stunt, Citrus exocortis,** Cumumber pale **fruit** etc.
- Viroids cause peristent infectioins, i.e. never recovered/

NOTE :

(i) Due to absence of protein coat viroids are also called as **naked virus.**

(ii) In virouds RNa, 246 to 388 nucleotides are present. They possesses the power of replication.

Virusoides :

Virusoides are like viroids, but are located inside the protein coat of a true virus, virusoid RNA can be either circular or linear. Virusoids are infectious by themselves because they are replicated only in the presence of their host.

Prions or Slow viruses :

1. In 1966, three **British scientists T. Alper, D. Haig** and **M. Clarke** discovered infectious agents which are even smaller than viriod. They coined the term **prion**. But credit goes to professor Stanley **B. Prusiner** for the detailed study of **Prions.** Nobel prize was awarded to profesdor **Prusiner** in 1997 for his significant contribution.
2. Prions lack their own genetic material (DNA or RNA). They are consisting of specific protein macro molecules which is known as **prion protein** or Prep.
3. According to Prusiner, in most of the animals prion protein is generally associated with the chemical substance found in the nerve cells of barin.
4. Prions are associated with **Kuru** (the laughing death) disease of man, **Creutzfeldt jakob** disease of humans and animals. **Scrapie disease** of sheep and goats, mad cow disease.
5. Prion casue disease of mental disorder.
6. In 1976 **D.G. Gujdusek** was awarded noble prize to the research of prion bases disease.

Interferons

- **G.M. Findely and McCallum** (1937) reported a phenomenon **called viral interference** in which the cell infected with one type virus becomes resistant to suerinfection by other viruses.
- **Alliac Issacs and Lindeman (1957)** gave the term **interferons** to the chemical substances responsible for viral interference.
- Interferons are produced by cells in mammals, rodents, birds, etc. and provide resistance against viruses.
- **Hilleman** and **A. Tydall** (1963) isolated interferon's from hen's egg infected with influenza virus.
- Interferons are protein molecules or polypeptides of **low molecular weight** which prevent Viral Multiplication.

DISEASES CAUSED BY VIRUSES

Plant diseases

1. tobacco mosaic disease
2. Leaf curl of **papaya**
3. Yellow vein mosaic of lady finger.
4. Potato leaf roll.
5. Vein handing mosaic disease of potato.
6. Grassy shoot of sugar cane.
7. Buncy top of banana.
8. Tungro disease of rice.
9. Tomato leaf curl

Human diseases

(A) Pneumotropic diseases (Related to respiratory tract) e.g. **Influenza, Adenovirus infection, Rhinovirus infection.**

(B) Dermotropic diseases (Related to skin) :

1. **Chicken pox- Varicella virus :** This virus also causes **Herpes zoster disease** in adults. Therefore this virus is also known as **v-z virus.**
2. **Smallpox-Variola virus.**
3. **Measles :** Highly communicable infection in children. Caused by Rubeola virus (Rube $\rightarrow$ Red).
4. **Mumps** or epidemic parotitis.
5. Herpes simplex.

(C) Viscerotropic diseases (Related to blood and organs).

1. **Rabies or Hydrophobia** (Highest mortality rate) : This virus contains **single stranded RNA**
2. **AID :** (Acquired Immun Deficinecy Syndrome).

- First case of AIDS was reported in **Atlanta** (1981).
- Males are more susceptible to this disease than females. (92.5% in males, 65% in women and about 1% in children).
- This virus spreads through **blood transfusion, sexual contact,** etc.
- This AIDS virus is known by different names as :
  - **(A) ARV :** AIDS associated Retrovirus.
  - **(B) LAV :** Lymphoadenopathy Associated Virus.
  - **(C) HLTV-III :** Human T-cell Lymphotropic Virus Type - III
  - **(D) HIV -** Human Immunodeficiency Virus.
- This virus contains **single stranded RNA.**
- AIDS virus likes **T-lymphocytes** which provide resistance to the organism through production of antibodies. This virus infects and skill T-lymphocytes (T-helper cells) and hence resistance of host is collapsed. Thus man is infected with different types of infections.

  [This is also known as Death Warrant]

3. **Yellow fever :** Transmitted by Aedes aegypti mosquito.
4. **Dengue fever :** Transmitted by Aedes aegypti and Culex fatigans mosquito.
5. **Polio :** Transmitted through food, water and contact.
6. **Hepatitis A :** Transmitted through food, water and contact.
7. **Hepatitis B :** Transmitted through contact and body fluids

VIRION :

- An infectious virus particle is called **VIRION.**
- Plant and animals viruses do not have their own infection power.
- Infection of plant virus with the help of a insect - **Aphids.**
- Infection of animal virus is depend upon **Mosquitoes.**
- Some of virus depend upon other virus for their infection. Such viruses are known as **satellite virus.**
- **Tobacco staellite virus :**

  This virus is depend upon **tobaccco necrosis virus** (ss RNA present) for the infection.

  Character of viral diseases in plant :
- Chlorophyll and other pigments changed into fluid (liquid) through the virus, so the pigments are not synthesized.
- Growth and life duration of the plants reduced.

  Blisters appears on the leaves and flowers of host due to high growth rate of viruses. So shapes of these becomes abnormal.
- Due the high metabolic activities, necrosis take place.

VIRUS : NOMENCLATURE

Binomila theory is not applicable on virus. According to **Gibbs** and **Harrison** (1968) name of virus of given by Cryptogram

I pair - Types of Nucleic acid/No. of strand is Nucleic Acid

(D = DNA, R = RNA 1 = Single strands, 2 = Double strand)

II pair - Molecular weight of N. Acid in million/% of Nucleic Acid in virus

III pair - Shape of virus/shape of capsed

(S = Spherical, E = Elongated, X=complex)

IV pair - Types of infected host / Types of vector

(A = Actinomycetees, B = Bacterium, F = Fungus, I = Invertebrates, V = Vertebrates, S = Seed plant)

Cryptogram of TMV - $\frac{R}{1}:\frac{2}{5}:\frac{E}{E}:\frac{S}{*}$

Influenza virus - $\frac{R}{1}:\frac{2-3}{10}:\frac{S}{E}:\frac{V}{A}$

Pox virus - $\frac{D}{2}:\frac{160}{5-7.5}:\frac{X}{*}:\frac{V}{*}$ (Pox virus also known as VIP virus)

T_4 Bacteriophage - $\frac{D}{2}:\frac{130}{4}:\frac{X}{X}:\frac{B}{*}$

Polio virus - $\frac{R}{1}:\frac{2.5}{30}:\frac{S}{s}:\frac{V}{*}$

Important Point :

- Virus which infects yeast - Zymophage
- λ**-Phage -** one tail fibre
- λ-Phage was discovered by Andre L.Woff.
- Cauliflower mosaic virus - ds DNA
- PSTV - Protein coat is absent

Note : Cynophages LPP-1 and SM-1 are useful in controlling water blooms.

MYCOPLASMA

Systematic position :

Earlier they ware included among bacteria. However, in 1966, international committee of Nomenclature of Bacteria recognized **Mycoplasmas** as different from bacteria and placed it under a separate class **Mollicutes.** The systematic position of **Mycoplasma** is as below :

Class - Mollicutes
Order - Mycoplasmatales
Family - Mycoplasmataceae
Genus - Mycoplasma

Discovery :

- These organism were first discovered by **Pasture** while studding the causative agent of **Bovine pleuropneumonia** in cattle. He could not isolate them in pure culture on standard nutrient media.
- In 1898, two **Frech** scientists **E. Nocard** and **R.Roux** while studying pleural fluids of cattle suffering from **pleuropneumonia** disease, discoverd the organisms which re known as mycoplasmas and were designated as **PPLO** (i.e. Pleuropneumonia like oragnism)
- **Nowkak** (1929) put these organism under the genus Mycoplasma and these organisms are now commonly called mollicutes (i.e. soft skin).
- **Borrel $\rightarrow$ Asterococcus mycoides.**
- **J. Elford** in 1937, isolate these oragnisms by special type of filters as they could not be separate by bacterial Mycoplasma.
- the Japaneese Doi et. al. (1967) first discovered that the **"Aster yellow"** diseases of plant are cuased by **Mycoplasma.** Doi et. al. named these poemorphic organimises as mycoplasma like oranisms (**MLO**). According to **Doi, phloem cells** (Sieve tube & phoem parenchyma) of plants re much affected by this diseases.

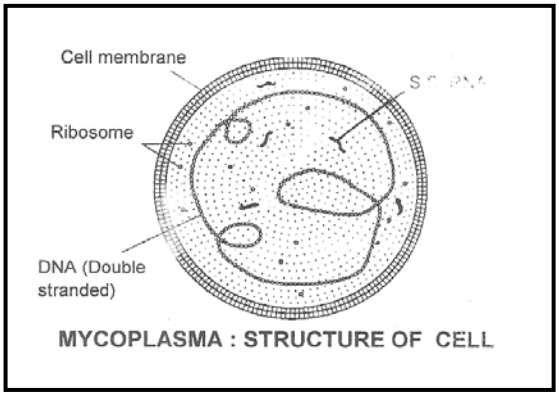
These organisms are variously designated as :

1. Cell wall less prokaryotes
2. Joker of the plant kingdom
3. Joker of the microbiology
4. Coat less bacteria
5. Photoplasma
6. Glaxoplasma
7. Auxaloplasma
8. Spheroplasma
9. Bedsonia

Diagnostic feature :

1. Mycoplasmas are non motile, unicellular, smallest ultra microscopic prokaryotic organisms. The smallest prokaryotic organism is **Mycoplasma llaidlawii,** the diameter of cell varies from 0.1 μm to 0.3 μm.
2. Mycoplamas may be the simplest form of life capable of independent growth, reproduction and metabolism.
3. They are cell wasll less hence, they exhibit peomorphism and thus called as Joker of plant kingdom.
4. They can be cultured on cell free culture medium and their shapes depend upon the nature of culture medium
5. They require sterols for their growth.
6. They posses both DNA and RNA as genetic material.
7. They are resistant to antibiotics asd **penicillin, ampicillin, cephaloridine** and **erythromycin** etc. that act on cell wall.
8. They are sensitive to **streptomycin, tetracycline** & **chloramphenicol** & **erythromycin** etc. that act on metabolic activities.

Structure :



MYCOPLASMA : STRUCTURE OF CELL

- Mycoplamas are ultramicroscopic, unicellular cell wall less organism.
- The outer most covering of cell is known as plasm membrane. It is tri-layered & made up of lipoprotein (75Å - 110 Å thickness).
- In cytoplasm double membrane bound cell organelles re absent. In cytoplasm ribosomes (70S type) are found in granular forms. protein occur in soluble forms.
- In this middle of the cell occurs a **incipient nucleus** or **nucleoid**. The nucleus of this type is devoid of nuclear membrane and nucleolus. The amount of **double stranded** DNA is **4** (mainly) to **6** percent of protoplasm while single stranded RNA is **8** (mainly) to 15 percent protoplasm.
- **Mesosomes** absent.

NOTE :

1. Three characteristic features of Mycoplams are :
   - They are lacking cell wall
   - Typical colonial appearance.
   - Filterability through 450 nm bacterial filters (J. Elford - Mycoplasma proof filter)

2. Structurally, Mycoplas ma alike as L - form bacteria.
   L - typical bacteria = 'Lysozyme rated bacteria without cell wall'.
   Their cell wall is destryoged by the action of Lysozyme enzyme.
   Gram positive L-typical bacteria are called **"Protoplast".**
   Gram positive L-typical bacteria are called **"spheroplast"**
3. Important difference between L-form bacteria adn Mycoplasma is that under optimum nutritional conditions. L-form bacteria will develop cell wall whereas mycoplasma will never develop cell wall.
   - L-form bacteria was discovered by **Klienberger** noble in 1935.
   - L- for -Lister institute (London), where these bacteria were reported.

NOTE :

- According to the some scientists **polar bodies** are present at the both side of mycoplasma gelisepticum which is assumed as site for enzymatic reactions.
- Mycoplasma is **anarobes** (Obligae (few) or Facultative (usually). Normally, it is saprophyte but sometimes may be paraiste.
- **Mycoplasma laid lazali -** obligate saprophyte.
- Osmotropic mode of nutrition is found in Mycoplasma.
- They required sterols for their growth in culture medium, because of their cell is unable to synthesize sterols. such as - cholesterol ergestrerol. (Acholeplasma do not require sterols for their growths)
- Growht of mycoplams on solid culture medium - (eg. Agar plate), is like a **"fried egg".**
- Growth of mycoplasma in liquid medium is annular (ring like).
- Mycoplasma is resistant to **Penicillin.**
- **Mycoplasma mycoides - Filamentous**
- **Mycoplasma pneumoniae -** Spherical
- They are **gram-ve** and sensitive to temp. pH (1-3, No growth) and super sonic waves.

REPRODUCTION IN MYCOPLASMA.

1. **Binary fission :** most common method of reproduction in Mycoplasma in **binary fission.**
2. **Fragmentation :** Specially in filamentous forms.
3. **By primary structures or "Elementary bodies" :** first of all, many **spherical strucures** are formed in mycoplasma. They are called **primary structures (0.1 μ)**. They after the Mycoplasma cell **degenerates** and then each elementary body **grow** into a new mycoplasma cell.

Symptoms of Plant diseases : Mycoplama caused chlorosis in plants. They destroyed chlorophyll.

Plants becomes dwarf in this disease. The infection of Mycoplasma develops excessive branching. Leaves becomes small. Many branches develops from the same place due to the growth of axillary bunds. This disease is known as **"witches broom"**

Transmission of disease -

(i) In plants the mycoplasmal diseases are usually transmitted by **leaf hopper.**

(ii) In addition, it is also transmitted by **grafting.**

(iii) In **pea** this disease in transmitted by **aphids (Acrythospihom pisum).**

(iv) By **Cuscutta**

(a) Plant disease

(i) Little leaf of Brijal.

(i) Bunchy top of **papaya.**

(ii) Witches broom of **Ground nut Legume/Potato**

(iii) Aster yellow disease of **sunflower.**

(iv) Stripe disease of sugar cane (v) Maize stunt, clover dawrf, mulberry dwarf.

(b) Animal disease : Mycoplasma infects the epithelium tissues in animal body.

(i) Penicillin resistant pneumonia : Example - **M. gelisepticum.**

(ii) Sterility/Genitals inflammation : M. hominis:

This Mycoplasma attacks on germinal epithelium of somniferous tubules of testis and caused -

(A) Oligospermia - Less production of sperms.

(B) Azospermia - formation of sperms inhibited.

(iii) **Mycoplasma salivarium** causes diseases of respiratory tract.

(iv) **Mycoplasma pneumoniae** causes **primary atypical pneumonia** (PAP).

(v) **Mycoplasma mycoides** causes **bovie pleuropneummia.**

Note :

Antibiotic proteins are formed in the host body by the infection of virus. These proteins are called **"Interferons"**

These interferons stops the infection of next virus.

In place of these **'photo alexins'** are formed in plants which prevent the plants form the infection of viruses, bacteria and fungi.

CULTURE OF MYCOPLASMA

- These can be cultured in non-living medium, although they grow well in living medium containing chick tissue
- In non-living medium, they requires cholesterol, ergesterol or agar-agar (obtained from red algae), blood serum and pH 7.8.