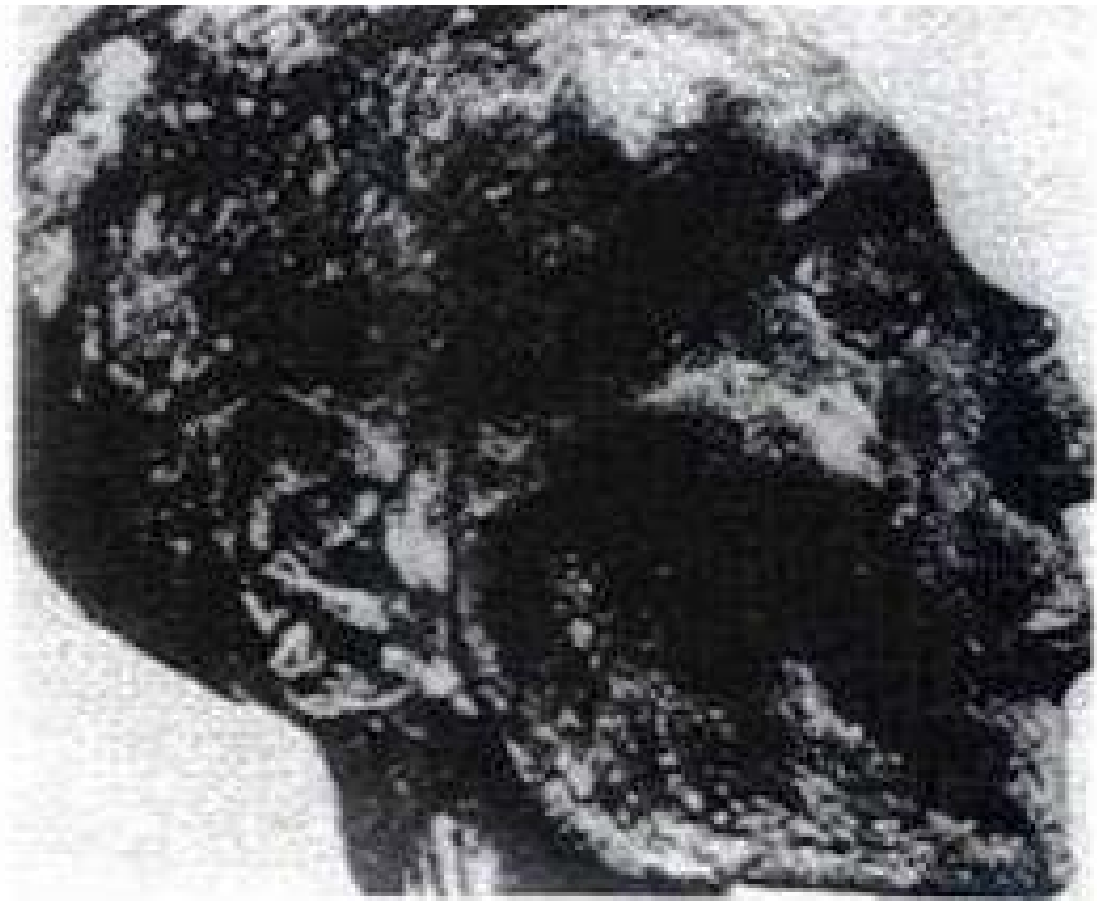


# **VIROLOGIA 2006/2007**

## **APRESENTAÇÃO 1**

**(História da Virologia e diversidade dos  
vírus eucarióticos)**

*Maria Filomena Caeiro*

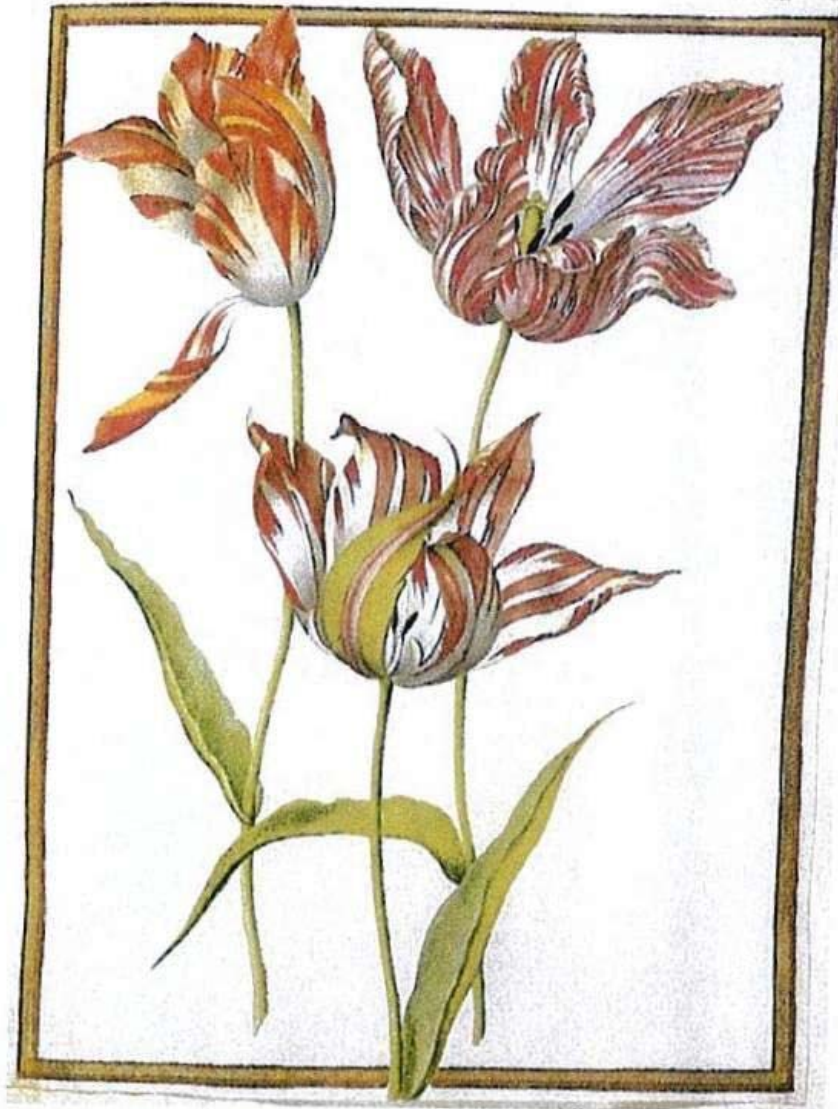


*Figure 4.2 Mummy of Ramses V, who died in his early thirties probably from smallpox in 1158 B.C. Smallpox lesions are visible on his lower face and neck.*



*An Egyptian stele, or stone tablet, from the eighteenth dynasty (1580–1350 B.C.) depicting a man with a withered leg characteristic of polio.*

**Biddle, W.** (1996) "A Field Guide to Germs". Anchor Books, Doubleday

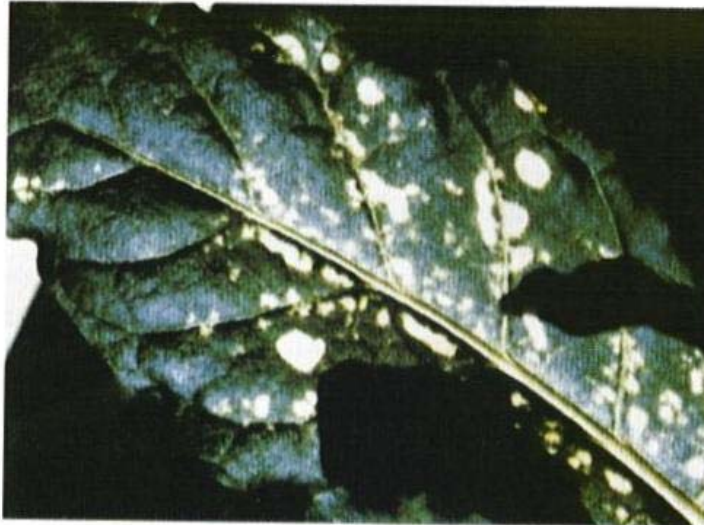


**Figure 1.2 Three Broken Tulips.** A painting by Nicolas Robert (1624–1685), now in the collection of the Fitzwilliam Museum, Cambridge, England. Striping patterns (color breaking) in tulips were described in 1576 in western Europe and were caused by a virus infection. This beautiful image depicts the remarkable consequences of infection with the tulip mosaic virus. Courtesy of the Fitzwilliam Museum, University of Cambridge.

Flint, S. J., Enquist, L. W., Krug, R. M., Racaniello, V. R. and Skalka, A. M. (2004). "Principles of Virology. Molecular Biology, Pathogenesis, and Control". 2nd edition. ASM Press.



A



B

Tobacco leaves infected with the tobacco mosaic virus.  
 A: An early systemic infection six days after inoculation.  
 B: A late systemic infection four weeks after inoculation.  
 Note the white spots, each of which is a site of virus infection, and the necrotic lesions.

Levine, A. J. (1992). "Viruses". Scientific American Library.





**Figure 1.3 Characteristic smallpox lesions in a young smallpox victim.** Illustrations like these were used to track down individuals infected with smallpox during the World Health Organization campaign to eradicate this disease. Photo courtesy of the Immunization Action Coalition (original source: Centers for Disease Control and Prevention).

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*Figure 4.4 The first vaccination is depicted in this painting. Edward Jenner is seen vaccinating eight-year-old James Phipps with vesicle fluid taken from the cowpox lesion on the hand of milkmaid Sarah Nilmes. Courtesy of the Wellcome Trust.*



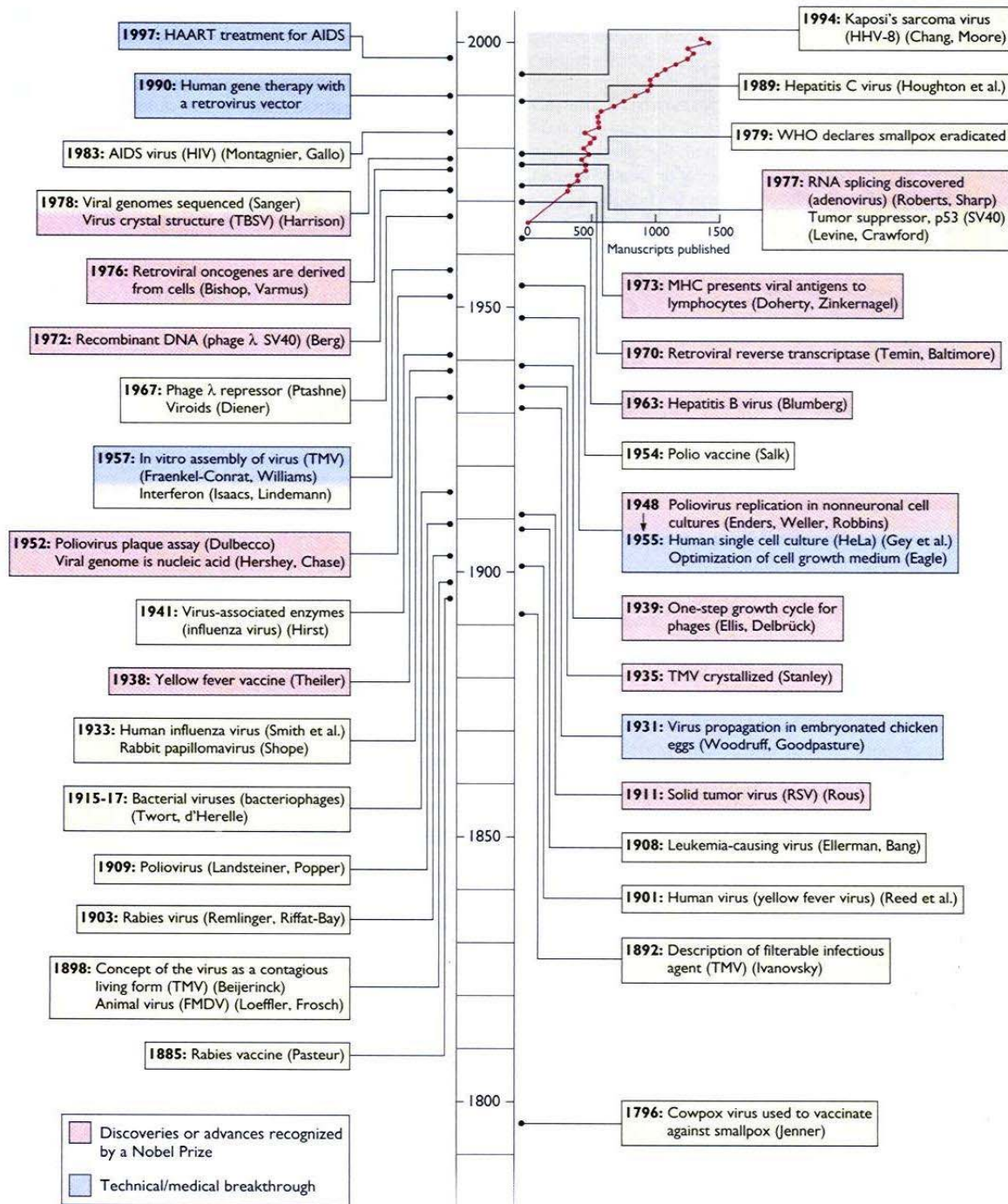


1802 cartoon, satirizing Jenner and "the Wonderful Effects of the New Inoculation!" On the wall of the room where cowpox vaccine is being administered hangs a picture of an Old Testament story: the worship of the Golden Calf.

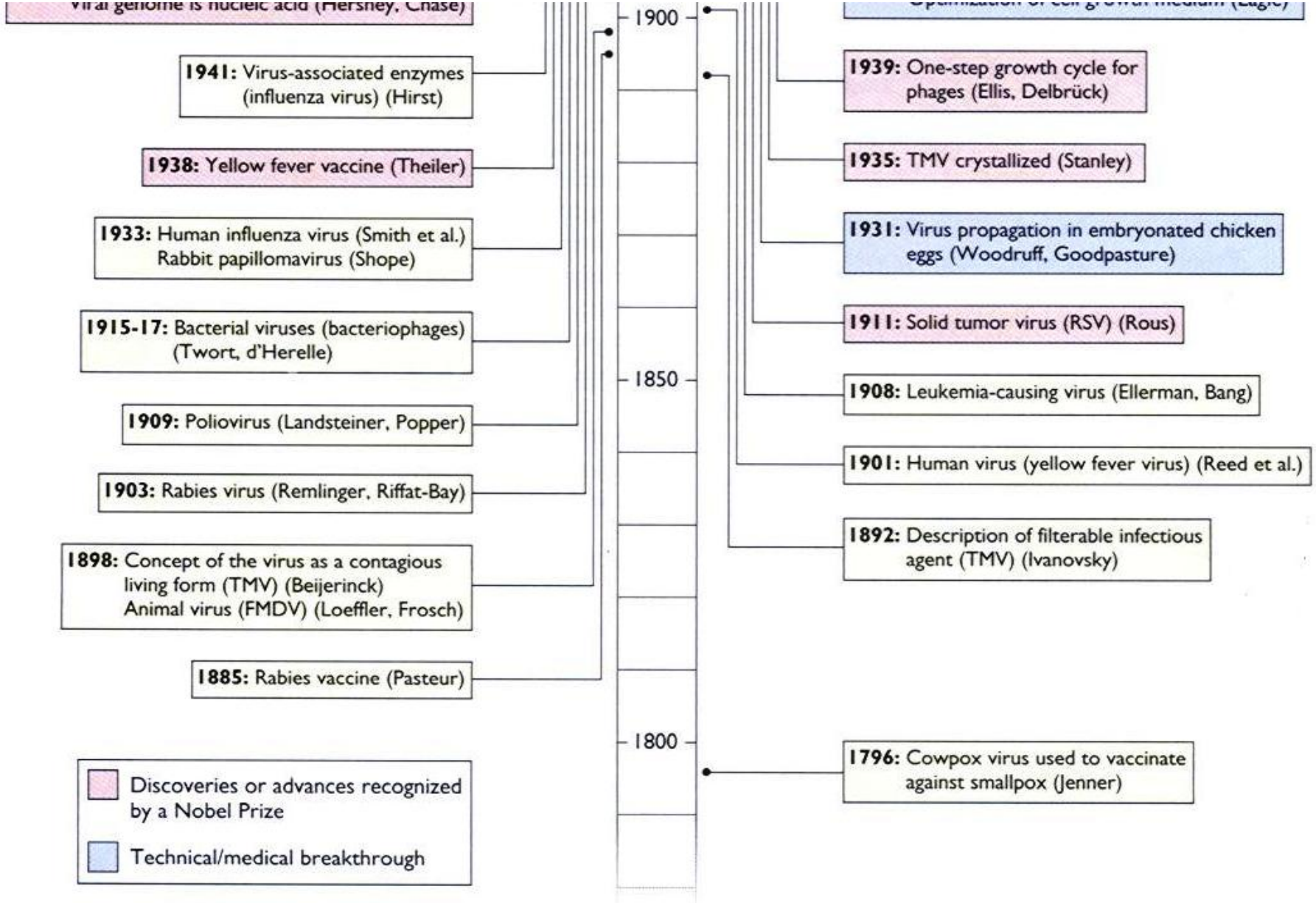




*Figure 4.5 Not all thought the procedure of vaccination to be wonderful. Painting by the anti-vaccinationist James Gillray in 1802 shows vaccinated persons with parts of cows growing out of their arms and bodies. Courtesy of the Wellcome Trust.*

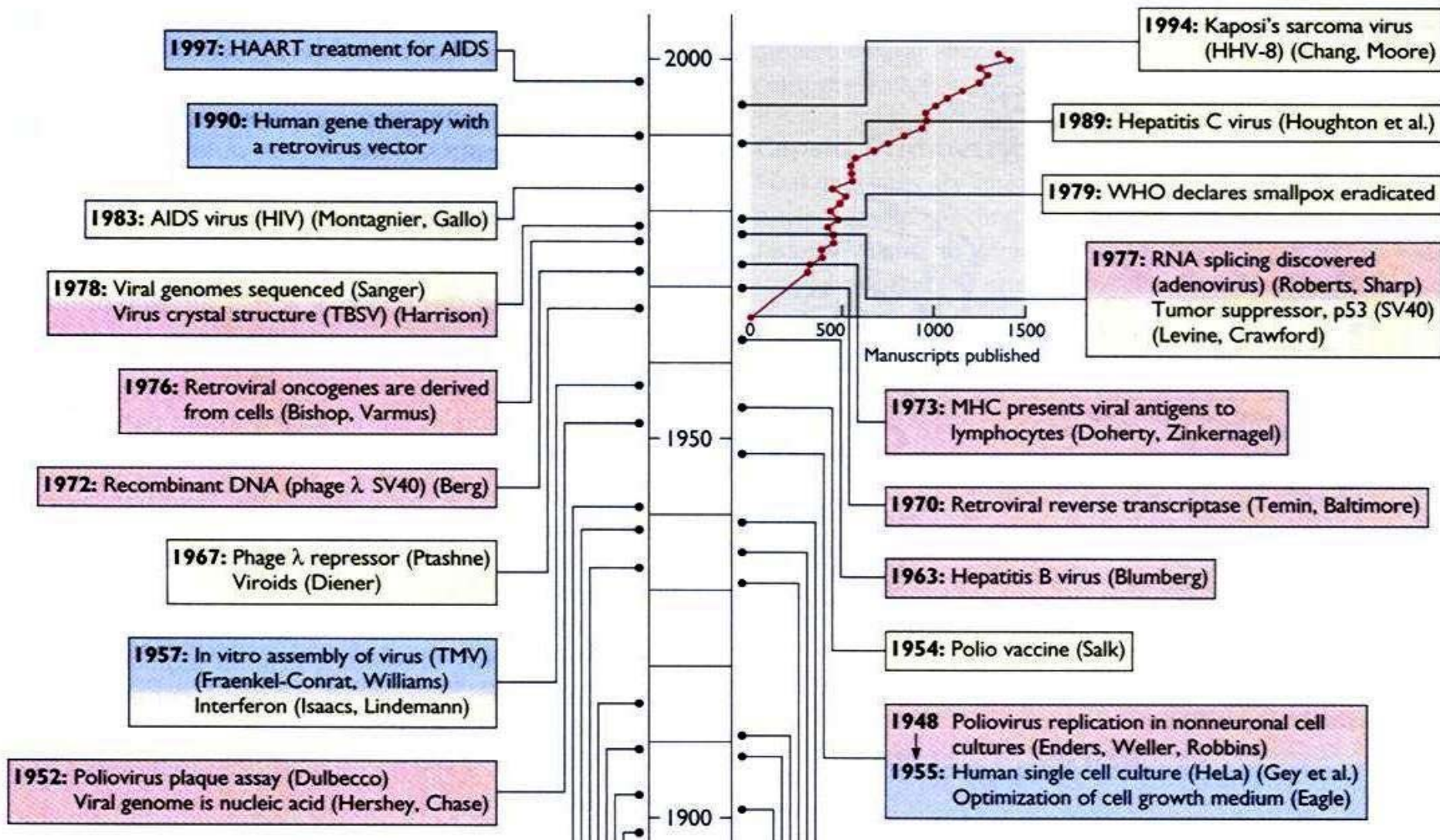


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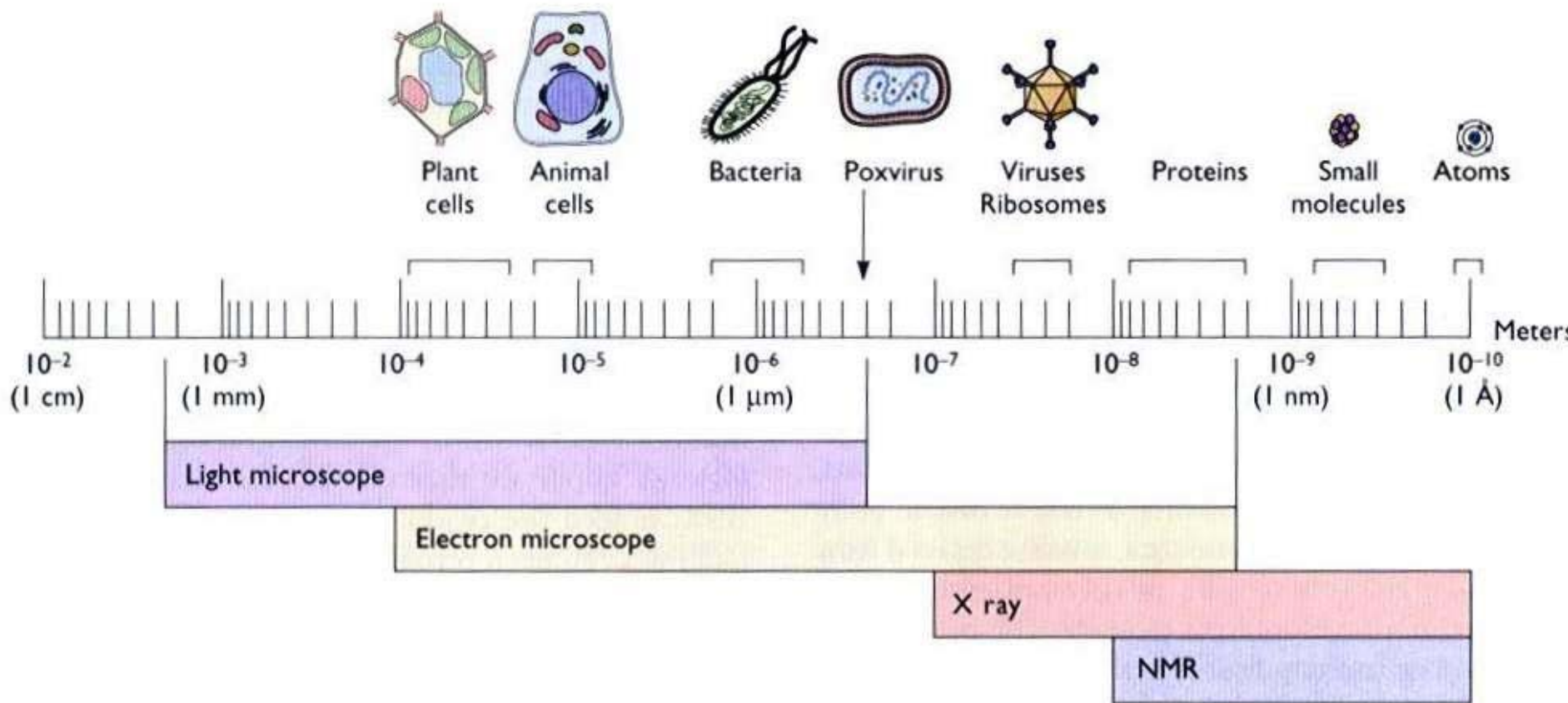


Racaniello, V. R. and Skalka, A. M. (2004). "Principles of Virology. Molecular Biology, Pathogenesis, and Control". 2nd edition. ASM Press.





Flint, S. J., Enquist, L. W., Krug, R. M., Racaniello, V. R. and Skalka, A. M. (2004). "Principles of Virology. Molecular Biology, Pathogenesis, and Control". 2nd edition. ASM Press.



**Figure 1.7 The small size of viruses is illustrated with a logarithmic, metric scale.** Sizes of animal and plant cells, bacteria, viruses, proteins, molecules, and atoms are indicated. The resolving powers of various techniques used in virology, including light microscopy, electron microscopy, X-ray crystallography, and nuclear magnetic resonance (NMR) spectroscopy, are indicated below the logarithmic size scale. Viruses, which are within the resolving power of the electron microscope, are about two orders of magnitude smaller than the smallest bacterium. The units commonly used in descriptions of virus particles or their components are the nanometer (nm [ $10^{-9}$  m]) and the angstrom ( $\text{\AA}$  [ $10^{-10}$  m]).



- A. *Properties of virions*
  - 1. Virion size
  - 2. Virion shape
  - 3. Presence or absence of an envelope and peplomers
  - 4. Capsomeric symmetry and structure
- B. *Properties of genome*
  - 1. Type of nucleic acid—DNA or RNA
  - 2. Strandedness—single stranded or double stranded
  - 3. Linear or circular
  - 4. Sense—positive, negative, or ambisense
  - 5. Number of segments
  - 6. Size of genome or genome segments
  - 7. Presence or absence and type of 5'-terminal cap
  - 8. Presence or absence of 5'-terminal covalently linked polypeptide
  - 9. Presence or absence of 3'-terminal poly(A) tract
  - 10. Nucleotide sequence
- C. *Properties of proteins*
  - 1. Number of proteins
  - 2. Size of proteins
  - 3. Functional activities of proteins (especially virion transcriptase, virion reverse transcriptase, virion hemagglutinin, virion neuraminidase, virion fusion protein)
  - 4. Amino acid sequence
- D. *Replication*
  - 1. Strategy of replication of nucleic acid
  - 2. Characteristics of transcription
  - 3. Characteristics of translation and posttranslational processing
  - 4. Site of accumulation of virion proteins, site of assembly, site of maturation and release
  - 5. Cytopathology, inclusion body formation
- E. *Physical properties*
  - 1. pH stability
  - 2. Thermal stability
  - 3. Cation ( $Mg^{2+}$ ,  $Mn^{2+}$ ) stability
  - 4. Solvent stability
  - 5. Detergent stability
  - 6. Radiation stability
- F. *Biological properties*
  - 1. Serological relationships
  - 2. Host range, natural and experimental
  - 3. Pathogenicity, association with disease
  - 4. Tissue tropisms, pathology, histopathology
  - 5. Transmission
  - 6. Vector relationships
  - 7. Geographic distribution

Levy, J. A., Fraenkel-Conrat, H. and Owens, R. A. (1994). "Virology". 3rd edition. Prentice-Hall, Inc.



## Propriedades com carácter taxonómico

### A. *Properties of virions*

1. Virion size
2. Virion shape
3. Presence or absence of an envelope and peplomers
4. Capsomeric symmetry and structure

### B. *Properties of genome*

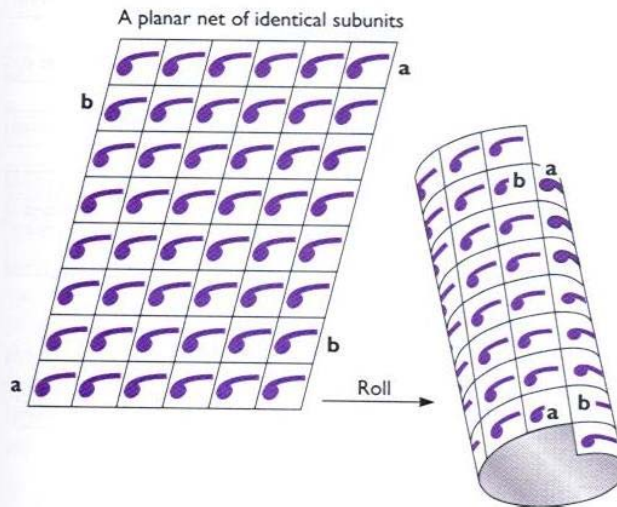
1. Type of nucleic acid—DNA or RNA
2. Strandedness—single stranded or double stranded
3. Linear or circular
4. Sense—positive, negative, or ambisense
5. Number of segments
6. Size of genome or genome segments
7. Presence or absence and type of 5'-terminal cap
8. Presence or absence of 5'-terminal covalently linked polypeptide
9. Presence or absence of 3'-terminal poly(A) tract
10. Nucleotide sequence

### C. *Properties of proteins*

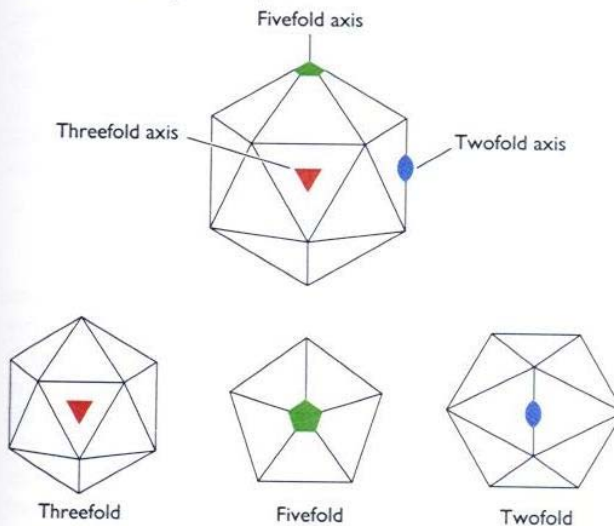
1. Number of proteins
2. Size of proteins
3. Functional activities of proteins (especially virion transcriptase, virion reverse transcriptase, virion hemagglutinin, virion neuraminidase, virion fusion protein)
4. Amino acid sequence

Levy, J. A., Fraenkel-Conrat, H. and Owens, R. A. (1994). "Virology". 3rd edition. Prentice-Hall, Inc.

### A Helical symmetry



### B Icosahedral symmetry



**Figure 1.12 Capsid architecture is based on principles of helical and icosahedral symmetry.** (A) A planar net of identical subunits and the same planar net rolled to form a helix. Many virions are rod-shaped (e.g., tobacco mosaic virus) with the viral RNA inside bound to the capsid protein subunits arranged on the outside with helical symmetry. (B) An icosahedron comprises 20 equilateral triangular faces with characteristic positions of rotational symmetry. The three views at the bottom highlight these positions.

Flint, S. J., Enquist, L. W., Krug, R. M., Racaniello, V. R. and . Molecular Biology Skalka, A. M. (2004). "Principles of Virology, Pathogenesis, and Control". 2nd edition. ASM Press.

## Propriedades com carácter taxonómico

### D. *Replication*

1. Strategy of replication of nucleic acid
2. Characteristics of transcription
3. Characteristics of translation and posttranslational processing
4. Site of accumulation of virion proteins, site of assembly, site of maturation and release
5. Cytopathology, inclusion body formation

### E. *Physical properties*

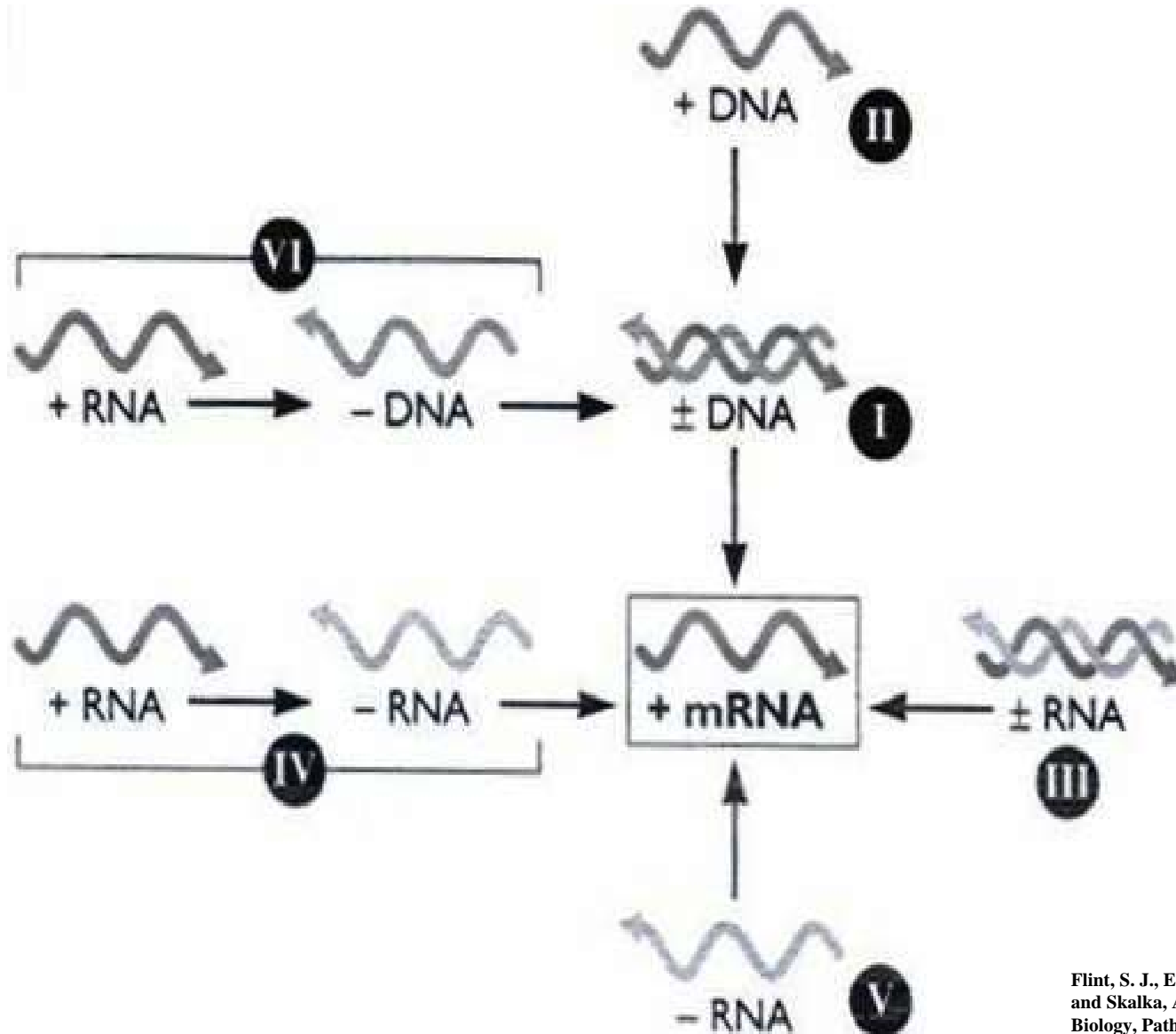
1. pH stability
2. Thermal stability
3. Cation ( $Mg^{2+}$ ,  $Mn^{2+}$ ) stability
4. Solvent stability
5. Detergent stability
6. Radiation stability

### F. *Biological properties*

1. Serological relationships
2. Host range, natural and experimental
3. Pathogenicity, association with disease
4. Tissue tropisms, pathology, histopathology
5. Transmission
6. Vector relationships
7. Geographic distribution



# CLASSIFICAÇÃO DE BALTIMORE



Flint, S. J., Enquist, L. W., Krug, R. M., Racaniello, V. R. and Skalka, A. M. (2004). "Principles of Virology. Molecular Biology, Pathogenesis, and Control". 2nd edition. ASM Press.

## **CLASSIFICAÇÃO DOS VÍRUS (ICTV):**

**Ordem:** ....virales

**Família:** ....viridae

**Subfamília:** ....virinae

**Gênero:** ....virus

**Espécie:** Designação vernácula  
(dificuldade em definir espécie...)

## **RELATÓRIO de 2 000 do ICTV:**

**3 ordens**

**56 famílias**

**9 subfamílias**

**233 gêneros**

**1550 espécies**

**E ... 30 000 a 40 000 isolados de vírus de bactérias, plantas e animais**

## Nucleic acid

## Symmetry of capsid

## Naked or enveloped

## Genome architecture

## Baltimore class

## RNA

## Icosahedral

## Helical

## Naked

## Enveloped

## Enveloped

ds  
10-18  
segmentsds  
2  
segments

(+) ss

(+) ss

(+) ss

(+) ss

(+) ss  
2 copies

(+) ss

(-) ss

(-) ss

(-) ss  
3  
segments(-) ss  
8  
segments

(-) ss

(-) ss  
2  
segments

III

III

IV

IV

IV

IV

VI

IV

V

V

V

V

V

V



## Family name

Reo

Birna

Calici

Picorna

Flavi

Toga

Retro

Corona

Filo

Rhabdo

Bunya

Ortho-  
myxoPara-  
myxo

Arena

## Virion polymerase

(+) |

(+) |

(-) |

(-) |

(-) |

(-) |

(+) |

(-) |

(+) |

(+) |

(+) |

(+) |

(+) |

(+) |

## Virion diameter (nm)

60-80 |

60 |

35-40 |

28-30 |

40-50 |

60-70 |

80-130 |

80-160 |

80 x  
790-14,000 |70-  
85 x  
130-380 |

90-120 |

90-120 |

150-300 |

50-300 |

## Genome size (total in kb)

22-27 |

7 |

8 |

7.2-8.4 |

10 |

12 |

3.5-9 |

16-21 |

12.7 |

13-16 |

13.5-21 |

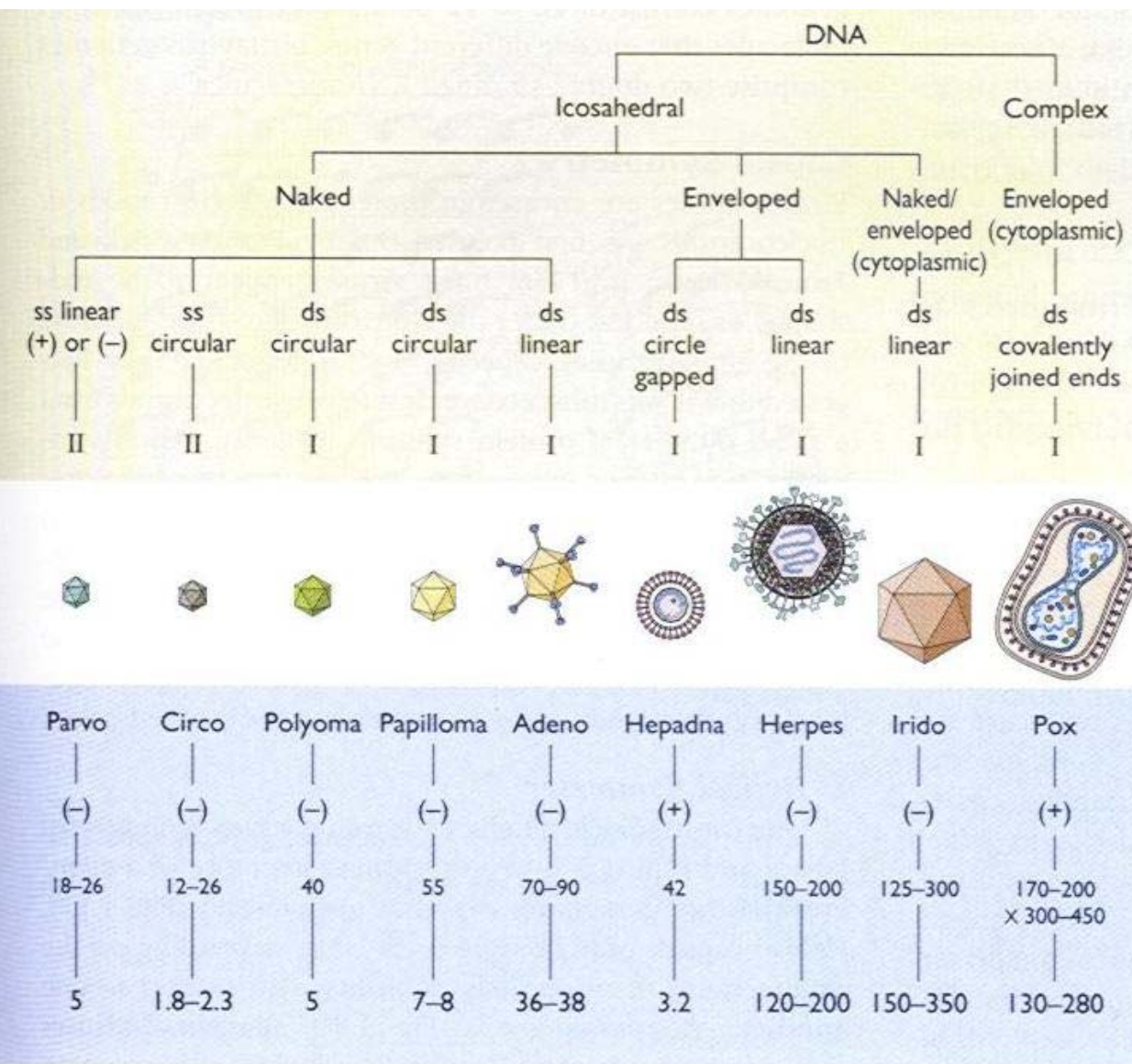
13.6 |

16-20 |

10-14 |

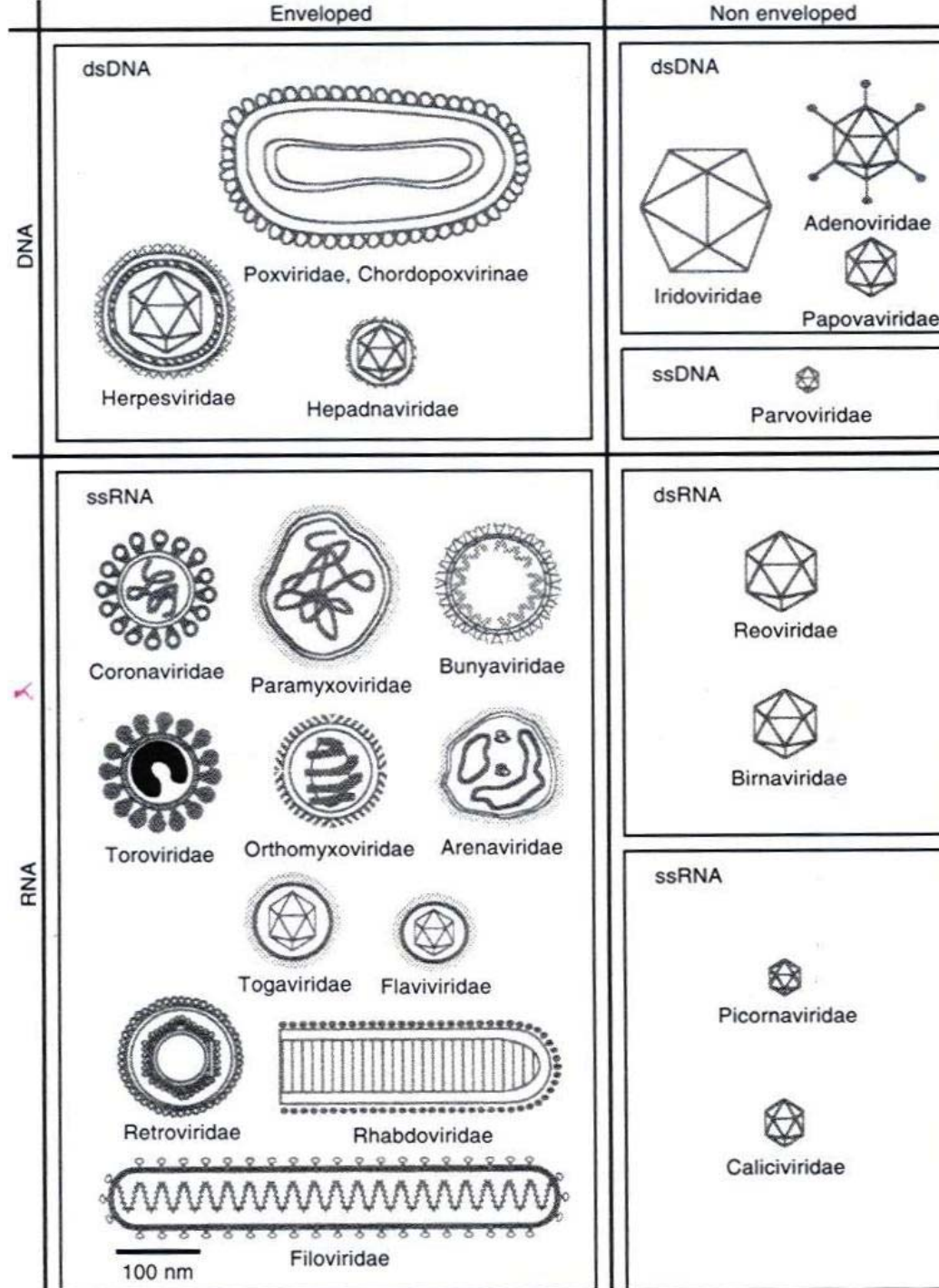
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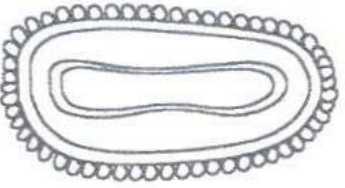
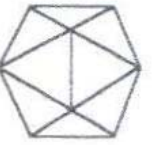
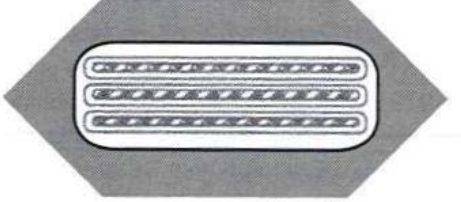







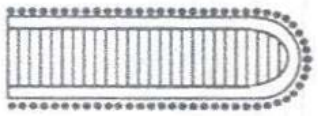




**Figure 1.10 Classification schemes for animal viruses.** Summary of the major characteristics of 23 representative families of viruses that infect vertebrates. Not all virus families are shown in the figure. Adapted from M. H. V. van Regenmortel et al. (ed.), *Virus Taxonomy: Classification and Nomenclature of Viruses*, Seventh Report of the International Committee on Taxonomy of Viruses (Academic Press, Inc., San Diego, Calif., 2000).

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## Famílias de Vírus que infectam Vertebrados

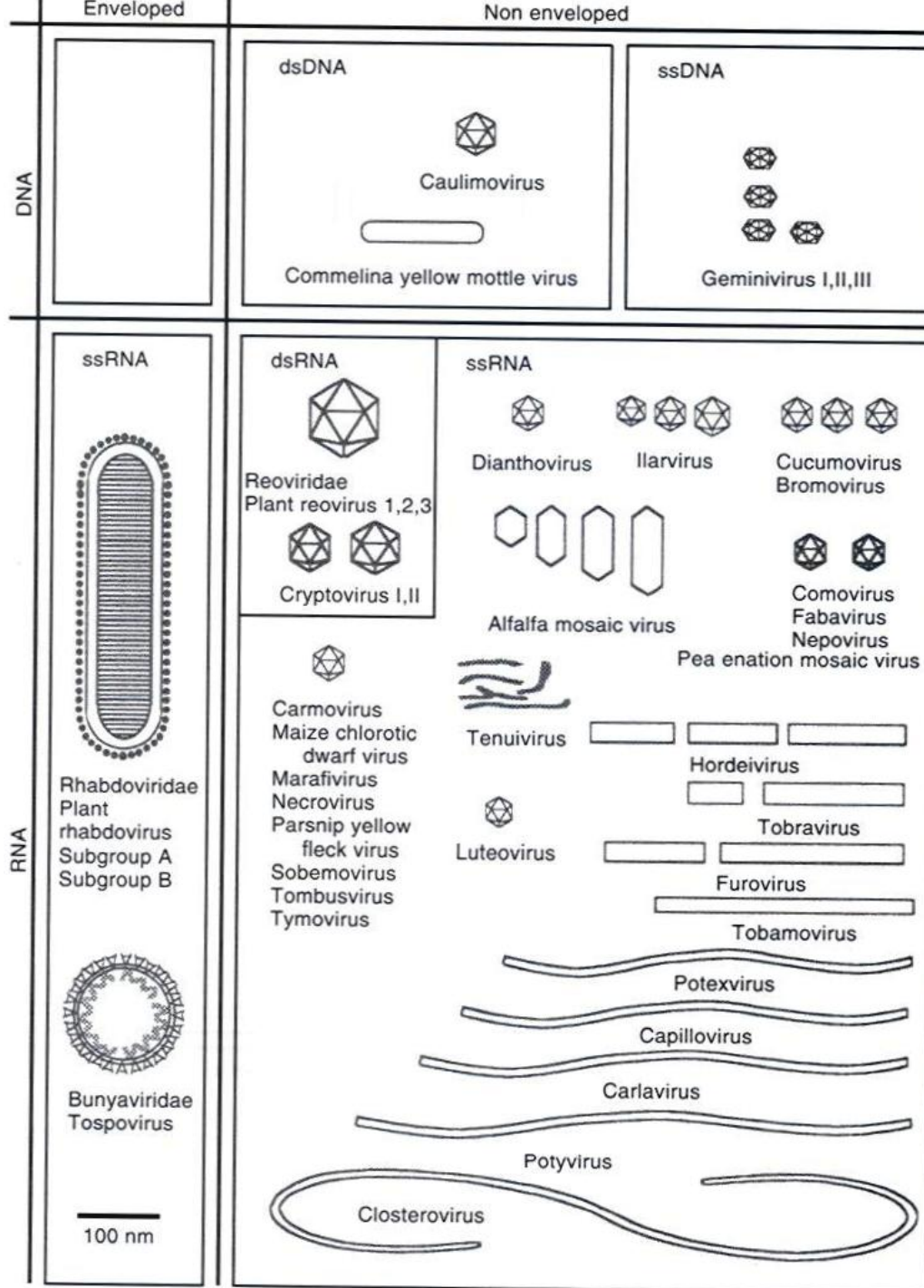
Levy, J. A., Fraenkel-Conrat, H. and Owens, R. A. (1994). "Virology". 3rd edition. Prentice-Hall, Inc.

		Enveloped	Non enveloped
DNA	dsDNA	 Poxviridae, Entomopoxviridae	 Iridoviridae
		 Baculoviridae, Eubaculovirinae	
		 Baculoviridae, Nudibaculovirinae	
		 Polydnaviridae, Ichnovirus	
		 Polydnaviridae, Bracovirus	
RNA	ssRNA	 Togaviridae	 Picornaviridae
		 Bunyaviridae	
		 Flaviviridae	
		 Rhabdoviridae	
		 Reoviridae	 Tetraviridae
		 Bimaviridae	 Nodaviridae

## Famílias de Vírus que infectam Invertebrados

Levy, J. A., Fraenkel-Conrat, H. and Owens, R. A. (1994). "Virology". 3rd edition. Prentice-Hall, Inc.





## Grupos de Vírus que infectam Plantas

Levy, J. A., Fraenkel-Conrat, H. and Owens, R. A. (1994). "Virology". 3rd edition. Prentice-Hall, Inc.



**TABLE 2.** *Families containing human and animal viruses*

Dividing characteristics	Virus family names
<i>RNA viruses</i>	
ssRNA, positive-sense, nonsegmented, nonenveloped	<i>Picornaviridae, Caliciviridae</i>
ssRNA, positive-sense, nonsegmented, enveloped	<i>Togaviridae, Flaviviridae, Coronaviridae</i>
ssRNA, negative-sense, nonsegmented, enveloped	<i>Rhabdoviridae, Filoviridae, Paramyxoviridae</i>
ssRNA, negative-sense, segmented, enveloped	<i>Orthomyxoviridae</i>
ssRNA, ambisense, segmented, enveloped	<i>Bunyaviridae, Arenaviridae</i>
dsRNA, positive-sense, segmented, nonenveloped	<i>Reoviridae, Birnaviridae</i>
ssRNA, DNA step in replication, positive-sense, nonsegmented, enveloped	<i>Retroviridae</i>
<i>DNA viruses</i>	
ss/dsDNA, nonenveloped	<i>Hepadnaviridae</i>
ssDNA, nonenveloped	<i>Parvoviridae</i>
dsDNA, nonenveloped	<i>Papovaviridae, Adenoviridae</i>
dsDNA, enveloped	<i>Herpesviridae, Poxviridae, Iridoviridae</i>