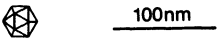
M

M13 phage. Filamentous phage containing a circular ssDNA genome (*see* INOVIRUS), which infects male *E. coli* cells (bearing the F pilus) without lysing them. The virus has been much used as a cloning vector for foreign DNA to produce cloned fragments of DNA in a single-stranded form that can then be sequenced by the SANGER METHOD. The foreign DNA is inserted into the purified replicative form (RF) of the virus which can be isolated in the same way as a plasmid. Derivatives of M13 RF DNA have been constructed (mp2-mp19; 'mp' from Max-Planck, the Institute where they were developed) containing part of the *E. coli lac* (= β-galactosidase) operon and suitable restriction enzyme sites. Successful insertion of foreign DNA into the viral derivatives can be detected visually as the insertion interrupts the β-galactosidase gene and causes recombinant phage plaques to be white rather than blue when suitable substrates (X-GAL) are incorporated into the medium.
Oliver, S.G. and Ward, J.M. (1985) A Dictionary of Genetic Engineering. Cambridge: Cambridge University Press.

Machlovirus group. (Sigla from maize chlorotic after the type virus MAIZE CHLOROTIC DWARF VIRUS). Genus of plant viruses with isometric particles, 30 nm. in diameter, which sediment at 180S and band in CsCl at 1.51 g/cc. The capsids



are composed of subunits of two polypeptide species (mw. 18 and 30 x 10^3). Each particle contains one molecule of ssRNA (mw. 3.2 x 10^6). Host range is narrow. Particles are found mainly in phloem cells. Machloviruses are not transmitted mechanically but by leafhoppers in the SEMI-PERSISTENT TRANSMISSION manner.
Matthews, R.E.F. (1982) Intervirology **17**, 137.
Francki, R.I.B. *et al.* (1985) **In** Atlas of Plant Viruses. Vol. 1. p. 111. CRC Press: Boca Raton, Florida.
Gingery, R.E. (1988) **In** The Plant Viruses. Vol. 3. p. 259. ed. R. Koenig. Plenum Press: New York.

Machupo virus. Synonym: BOLIVIAN HAEMORRHAGIC FEVER VIRUS. Family *Arenaviridae*, genus *Arenavirus*. Causes severe haemorrhaging and frequently death. Sporadic outbreaks occur. Natural host is the rodent *Calomys callosus*.

Maclura mosaic virus. A possible *Potyvirus*.
Koenig. R. *et al.* (1981) CMI/AAB Descriptions of Plant Viruses No. 239.
Francki, R.I.B. *et al.* (1985) **In** Atlas of Plant Viruses. Vol. 2. p. 183. CRC Press: Boca Raton, Florida.

macromolecule. A molecule having a molecular weight in the range of a few thousands to many millions.

Macropipus paralysis virus. Unclassified REOVIRUS-like agent ('P-virus') isolated from the swimming crab, *Macropipus depurator*. Virions sediment at 430S and contain ten segments of dsRNA. Often associated with a bunya-like virus ('S-virus'), which has a genome of three pieces of ssRNA.
Bergoin, M. *et al.* (1982) **In** Invertebrate Pathology and Microbial Control. p. 523. Proc. IIIrd Internat. Colloq. Invertebr. Pathol.

mad itch virus. *See* AUJESZKY'S DISEASE VIRUS.

Madrid virus. Family *Bunyaviridae*, genus *Bunyavirus*. Isolated from a man with fever and from sentinel mice, rats and mosquitoes in Panama. Antibodies found in a few humans.

Maedi virus. Family *Retroviridae*, subfamily *Lentivirinae*. Causes chronic pulmonary disease of sheep. Similar to VISNAVIRUS. Often referred to

as Maedi-Visna group.

Maguari virus. Family *Bunyaviridae*, genus *Bunyavirus*. Isolated from a horse in Guyana and from mosquitoes and sentinel mice in Brazil. Antibodies found in cattle, sheep and birds.

mahogany hammock virus. Family *Bunyaviridae*, genus *Bunyavirus*. Isolated from mosquitoes and a cotton rat in Florida.

main drain virus. Family *Bunyaviridae*, genus *Bunyavirus*. Isolated from hares and mosquitoes in California. Antibodies found in cattle and sheep.

maize chlorotic dwarf virus. Type member of the *Machlovirus* group.
Gingery, R.E. *et al.* (1978) CMI/AAB Descriptions of Plant Viruses No. 194.
Gingery, R.E. (1988) **In** The Plant Viruses. Vol. 3. p. 259. ed. R. Koenig. Plenum Press: New York.

maize chlorotic dwarf virus group. *See* MACHLOVIRUS GROUP.

maize chlorotic mottle virus. A possible *Sobemovirus*.
Gordon, D.T. *et al.* (1984) CMI/AAB Descriptions of Plant Viruses No. 284.
Hull, R. (1988) **In** The Plant Viruses. Vol. 3. p. 113. ed. R. Koenig. Plenum Press: New York.

maize dwarf mosaic virus. *See* SUGARCANE MOSAIC VIRUS.

maize mosaic virus. A probable plant *Rhabdovirus*, subgroup 2; transmitted by leafhopper.
Herold, F. (1972) CMI/AAB Descriptions of Plant Viruses No. 94.
Francki, R.I.B. *et al.* (1985) **In** Atlas of Plant Viruses. Vol. 1. p. 73. CRC Press: Boca Raton, Florida.

maize rayado Colombiano virus. A strain of MAIZE RAYADO FINO VIRUS.

maize rayado fino virus. Synonym: BRAZILIAN CORN STREAK VIRUS. Type member of the *Marafivirus* group.
Gamez, R. (1980) CMI/AAB Descriptions of Plant Viruses No. 220.
Gamez, R. and Leon, P. (1988) **In** The Plant Viruses. Vol. 3. p. 213. ed. R. Koenig. Plenum Press: New York.

maize rayado fino virus group. Synonym: MARAFIVIRUS GROUP.

maize rough dwarf virus. A *Phytoreovirus*.
Lovisolo, O. (1971) CMI/AAB Descriptions of Plant Viruses No. 72.

maize sterile stunt virus. A possible plant *Rhabdovirus*, subgroup 1; transmitted by leafhopper.
Francki, R.I.B. *et al.* (1985) **In** Atlas of Plant Viruses. Vol. 1. p. 73. CRC Press: Boca Raton, Florida.

maize streak virus. Type member of the *Geminivirus* group, subgroup A. The genome comprises one species of ssDNA of 2687 nucleotides. The virus causes an important disease of maize in Africa.
Bock, K.R. (1974) CMI/AAB Descriptions of Plant Viruses No. 133.
Harrison, B.D. (1985) Ann. Rev. Phytopath. **23**, 55.

maize stripe virus. A member of the *Tenuivirus* group.
Gingery, R.E. (1985) AAB Descriptions of Plant Viruses No. 300.

maize white line mosaic virus. An unclassified plant virus with isometric particles, 35 nm. in diameter which sediment at 117S and band in CsCl at 1.35 g/cc. The capsids are composed of coat protein subunits of mw. 32-35 x 10^3 and contain a single species of ssRNA (mw. 1.25 x 10^6).
de Zoeten, G.A. and Reddick, B.B. (1984) CMI/AAB Descriptions of Plant Viruses No. 283.

Makonde virus. *See* UGANDA S VIRUS.

Malaya disease. A disease of the coconut rhinoceros beetle (*Oryctes rhinoceros*) caused by a NON-OCCLUDED BACULOVIRUS (*see* ORYCTES RHINOCEROS VIRUS).

malignant catarrhal fever virus. Synonym: BOVID HERPESVIRUS 3. Family Herpesviridae, subfamily Alphaherpesvirinae. Causes a fatal disease of cattle with fever, acute inflammation of nasal and oral membranes and involvement of pharynx and lungs. Disease can be transmitted experimentally to cattle and rabbits. Can be grown in bovine thyroid and adrenal cell cultures.

Malva sylvestris rhabdovirus. A possible plant *Rhabdovirus*.
Matthews, R.E.F. (1982) Intervirology **17**, 114.

Malva vein clearing virus. A possible *Potyvirus*.
Francki, R.I.B. *et al.* (1985) **In** Atlas of Plant Viruses. Vol. 2. p. 183. CRC Press: Boca Raton, Florida.

Malva veinal necrosis virus. A possible *Potexvirus*.
Francki, R.I.B. *et al.* (1985) **In** Atlas of Plant Viruses. Vol. 2. p. 159. CRC Press: Boca Raton, Florida.

Malva yellows virus. A *Luteovirus*; considered to be a strain of BEET WESTERN YELLOWS VIRUS.
Francki, R.I.B. *et al.* (1985) **In** Atlas of Plant Viruses. Vol. 1. p. 137. CRC Press: Boca Raton, Florida.
Casper, R. (1988) **In** The Plant Viruses. Vol. 3. p. 235. ed. R. Koenig. Plenum Press: New York.

Mamestra brassicae nuclear polyhedrosis virus. A BACULOVIRUS (Subgroup A) isolated from the cabbage moth, *M. brassicae*. The virus is of the MNPV type and a range of related genotypic variants has been isolated from different geographical locations within Europe. The most extensively studied genotype is closely related (90% homology) to an MNPV isolated from the American bollworm, *Heliothis armigera*. The virus has a relatively broad host range, infecting at least 20 species of Noctuidae (Lepidoptera). The virus is produced on a commercial basis (*see* 'MAMESTRIN') in France as a selective biological control agent for *M. brassicae*, and used in Africa for the control of the cotton pests *H. armigera* and *Diparopsis watersi*. The virus replicates in some cell lines derived from *M. brassicae*.
Allaway, G.P. and Payne, C.C. (1984) Ann. appl. Biol. **105**, 29.

Mamestrin. Commercial product of the NUCLEAR POLYHEDROSIS VIRUS of the cabbage moth, *Mamestra brassicae*, from Calliope, Béziers, France. The preparation is used for the control of several noctuid pests including *M. brassicae* and the cotton pests, *Heliothis armigera* and *Diparopsis watersi*.

Mammalian type C Oncoviruses. Family *Retroviridae*, genus *Oncovirinae*. A subgenus in the genus *Type C Oncovirus*.

Manawa virus. Family *Bunyaviridae*, genus *Bunyavirus*. Isolated from ticks in West Pakistan.

Manawatu virus. *See* NODAVIRUS.

many polyhedra variant. Plaque variant of nuclear polyhedrosis virus which produces many polyhedra in infected nuclei in insect cell cultures. *See* FEW POLYHEDRA VARIANT.

Manzanilla virus. Family *Bunyaviridae*, genus *Bunyavirus*. Isolated from a monkey in Trinidad.

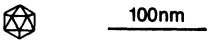
map. As a verb: to determine the position of genes or restriction endonuclease sites on a DNA. Gene mapping is done by mating experiments to determine the frequency of recombination between them. The further genes are apart the greater the frequency of recombination. Restriction endonuclease mapping is by sequential cutting of the DNA and measurement of the size of the resultant fragments. As a noun: a diagram showing the relative positions of genes or restriction endonuclease sites on a nucleic acid.

Mapputta virus. Family *Bunyaviridae*, genus *Bunyavirus*. Isolated from mosquitoes in Queensland, Australia. Antibodies found in man, cattle, horses, pigs, kangaroos and rats.

Maprik virus. Family *Bunyaviridae*, genus *Bunyavirus*. Isolated from mosquitoes in New Guinea.

Maracuja mosaic virus. A *Tobamovirus*.
Brunt, A.A. (1986) **In** The Plant Viruses. Vol. 2. p. 283. eds. M.H.V. van Regenmortel and H. Fraenkel-Conrat. Plenum Press: New York.

Marafivirus group. (Sigla from maize rayado fino, the type member). Genus of plant viruses with isometric particles, 31 nm. in diameter, which sediment as two components (120 and 54S) and form two bands in CsCl (1.46 and 1.28 g/cc). The capsids are made up of two polypeptide



species (mw. 29 and 22 x 10^3) in the ratio of 1:3. Particles contain one species of linear (+)-sense ssRNA (mw. 2.0-2.4 x 10^6). Host ranges are narrow and confined to Graminae. Virus particles

are found mainly in chlorenchyma and phloem parenchyma cells. Members are not transmitted mechanically. They are transmitted by leafhoppers in the PERSISTENT TRANSMISSION manner; they replicate in the leafhopper vector.
Gomez, R. and Leon, P. (1988) **In** The Plant Viruses. Vol. 3. p. 212. ed. R. Koenig. Plenum Press: New York.

Marburg virus. Member of the family *Filoviridae*. Causes a severe and often fatal disease of man. There is a sudden onset of fever, head and limb pains, diarrhoea, vomiting and confused mental state. Cardiac and renal failure with haemorrhaging develops. First reports could all be traced to contact with tissue from a batch of African green monkeys trapped in Uganda. Some secondary cases occurred, probably transmitted by blood, from infected patients. The virus causes fatal infection in monkeys and guinea pigs. It can be grown in a variety of tissue culture cells. The virus particles have some resemblance to rhabdoviruses but have now been allotted to a new family, *Filoviridae*.

Marco virus. Family *Rhabdoviridae*, not allotted to genus. Isolated from a lizard in Brazil. Pathogenic when injected into new-born mice. Replicates in mosquitoes infected experimentally. Grows well in Vero cells.

Marek's disease. Synonym: GALLID HERPESVIRUS 1. Family *Herpesviridae*, subfamily *Gammaherpesvirinae*. A natural infection of several species of bird causing progressive paralysis. Lymphoid tumours are produced. Can be grown in avian cultures in which the virus is cell-aassociated. An economically important disease of fowl which has led to the development of a highly successful attenuated vaccine.

marigold mottle virus. A possible *Potyvirus*. Francki, R.I.B. *et al.* (1985) **In** Atlas of Plant Viruses. Vol. 2. p. 183. CRC Press: Boca Raton, Florida.

Marituba virus. Family *Bunyaviridae*, genus *Bunyavirus*. Isolated from sentinel monkeys, mice and mosquitoes in Brazil. Causes fever in man. Antibodies found in several species of rodent living in forests.

marker rescue. The production of infective progeny virus from co-infections between one virus which lacks a specific gene function and another related or unrelated virus.

marsupial papilloma virus. *See* QUAKKA POXVIRUS.

Mason-Pfizer monkey virus. Family *Retroviridae*, subfamily *Oncovirinae*, type D retrovirus group. Isolated from a mammary carcinoma in a Rhesus monkey and also from placental tissue of normal animals. It has not been transmitted experimentally in monkeys. Transforms Rhesus foreskin cell cultures.

mast cell. A connective-tissue cell with numerous large basophilic metachromatic granules in the cytoplasm.

Mastadenovirus. (Greek 'mastos' = breast.) A genus in the family *Adenoviridae* consisting of those viruses isolated from mammals. The species take their name from the host species. They do not cross-react with the aviadenoviruses in serological tests.

matrix protein. A term used for several different types of protein. In INCLUSION BODIES it is the major protein making up the structure of the inclusion. In ORTHO- AND PARA-MYXOVIRUSES and RHABDOVIRUSES it refers to the protein between the viral membrane and the nucleocapsid.

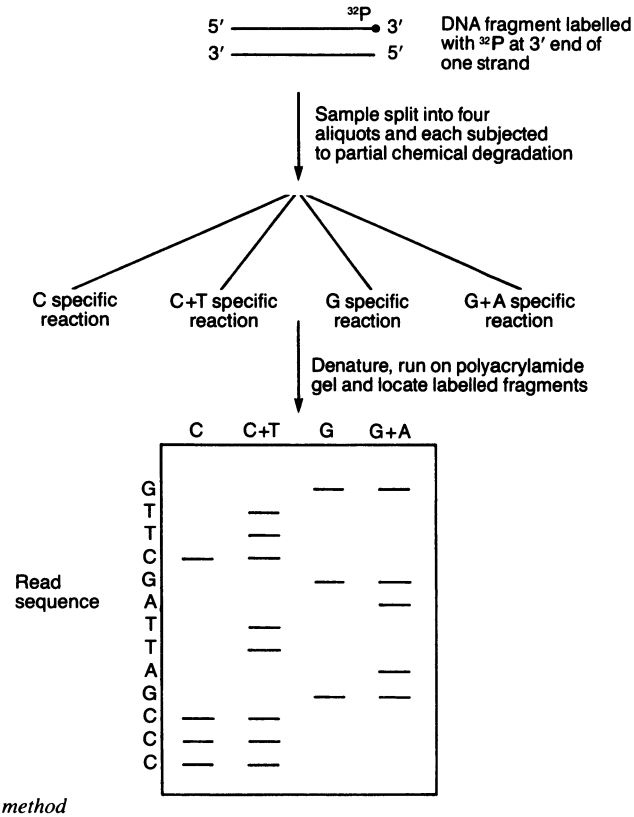
Matruh virus. Family *Bunyaviridae*, genus *Bunyavirus*. Isolated from birds in Egypt and Italy.

Maus-Elberfeld virus. Family *Picornaviridae*, genus *Cardiovirus*. A virus which is closely related serologically to ENCEPHALOMYOCARDITIS VIRUS of mice.

Maxam and Gilbert method. A method of sequencing DNA using chemical base-specific modification and cleavage. The DNA is end-labelled (*see* POLYNUCLEOTIDE KINASE) and the various reactions are set up for cleavages at specific nucleotides. The cleaved labelled fragments are then separated on a polyacrylamide gel which gives a sequence ladder. *See* SANGER METHOD.
Maxam, A. and Gilbert, W. (1980) Meth. Enzymol. **65**(1), 497.

Mayaro virus. Family *Togaviridae*, genus *Alphavirus*. Causes fever and severe headaches.

measles virus. Synonyms: ROUGEOLE VIRUS,



Maxam and Gilbert method

RUBEOLA VIRUS, MORBILLI VIRUS. Family *Paramyxoviridae*, genus *Morbillivirus*. Causes an acute febrile illness in children. Associated with cough, coryza and conjunctivitis, spots on the buccal mucosa and rash on the head and neck, spreading to the remainder of the body. Encephalitis also occurs in some cases. Can cause death in under-nourished children. Sub-acute sclerosing panencephalitis, a progressive degenerative disease of the central nervous system, is regarded as due to chronic infection with measles. Monkeys are susceptible and develop a disease similar to that seen in man. Virus can be adapted to grow in mice, ferrets and hamsters. Can be grown in human or monkey kidney cell cultures and in several other cell lines and eggs. An effective attenuated vaccine is in widespread use. The virus is closely related antigenically to those causing canine distemper, rinderpest and peste des petits ruminants.

mechanical inoculation. Inoculation of plants by rubbing sap or other viral extract on to the leaves. Often an abrasive such as celite (diatomaceous earth) or carborundum is included in the inoculum. The virus enters through small wounds made in the leaf cuticle and the walls of epidermal cells.

median effective dose (ED_{50}). The amount of, e.g. a drug, required to produce a response in 50% of the subjects to whom it is given.

median effective time (ET_{50}). The time taken, e.g. for a drug, to produce a response in 50% of the subjects to whom it has been given.

median infective dose (ID_{50}). The dose, e.g. of a virus, which, on average, will infect 50% of the individuals to whom it is administered. These may be animals, tissue cultures or eggs; with eggs the term EID_{50} (egg infective dose) is often used.

median lethal concentration (LC_{50}). The concentration of an agent (e.g. virus) which is re-

quired to kill 50% of the subjects to whom it is administered.

median lethal dose (LD_{50}). The dose of a substance which is fatal to 50% of the test animals.

median lethal time (LT_{50}). The period of time required for 50% of a group of organisms to die following a specific dose of an injurious agent, e.g. virus, drug or radiation.

median survival time (ST_{50}). The period of time at which half the subjects have died following the administration of an injurous agent (e.g. virus, drug or radiation).

median tissue culture infective dose ($TCID_{50}$). The dose (e.g. of a virus) which, on average, will infect 50% of susceptible tissue culture cells.

Melandrium yellow fleck virus. A possible *Bromovirus*.
Hollings, M. and Horvath, J. (1981) CMI/AAB Descriptions of Plant Viruses No. 236.
Francki, R.I.B. (1985) **In** The Plant Viruses. Vol. 1. p. 1. ed. R.I.B. Francki. Plenum Press: New York.

Melao virus. Family *Bunyaviridae*, genus *Bunyavirus*. Isolated from mosquitoes in Trinidad and Brazil.

Melilotus latent virus. A plant *Rhabdovirus*, subgroup 2.
Francki, R.I.B. *et al.* (1985) **In** Atlas of Plant Viruses. Vol. 1. p. 73. CRC Press: Boca Raton, Florida.

Melilotus mosaic virus. A possible *Potyvirus*.
Francki, R.I.B. *et al.* (1985) **In** Atlas of Plant Viruses. Vol. 2. p. 183. CRC Press: Boca Raton, Florida.

Melolontha entomopoxvirus. Type species of probable subgenus A insect poxviruses (*Entomopoxviridae*) from the cockchafer, *M. melolontha* (Coleoptera). Virions are oval, 450 x 250 nm., containing a unilaterally concave core and one lateral body. Particle surface has globular subunits 22 nm. in diameter. The genome is a single linear molecule of dsDNA, mw. approximately 200 x 10^6. During replication, virions are occluded in large occlusion bodies (SPHEROIDS) 10-24 µm in diameter. Spindle-shaped inclusions devoid of virions are also produced. Viruses with similar properties have been isolated from *Othnonius, Demodena, Geotrupes, Dermolepida, Aphodius, Anomala, Phyllopertha* spp. and *Figulus* sp. (Coleoptera).
Arif, B.M. (1984) Adv. virus Res. **29**, 195.

melon necrotic spot virus. A member of the *Carmovirus* group.
Hibi, T. and Furuki, I. (1985) AAB Descriptions of Plant Viruses No. 302.
Morris, T.J. and Carrington, J.C. (1988) **In** The Plant Viruses. Vol. 3. p.73. ed. R. Koenig. Plenum Press: New York.

melon rugose mosaic virus. A *Tymovirus*.
Jones, P. *et al.* (1986) Ann. Appl. Biol. **108**, 303.

melon variegation virus. A possible plant *Rhabdovirus*, subgroup 1.
Francki, R.I.B. *et al.* (1985) **In** Atlas of Plant Viruses. Vol. 1. p. 73. CRC Press: Boca Raton, Florida.
Hollings, M. and Horvath, J. (1981) CMI/AAB Descriptions of Plant Viruses No. 236.
Francki, R.I.B. (1985) **In** The Plant Viruses. Vol. 1. p. 1. ed. R.I.B. Francki. Plenum Press: New York.

melting temperature. The temperature at which a DNA or RNA molecule denatures into separate single strands without secondary structure. It is usually applied to ds nucleic acid and is characteristic for each nucleic acid species and is dependent on the guanosine + cytosine (G+C) content of the nucleic acid as well as the salt concentration of the solution. It is higher for RNA than for DNA. For dsDNA these parameters are related by the following formulae:

$$Tm = 69.3 + 0.41(G+C)\%$$

$$Tm = \frac{(G+C)\%}{2.44} + 81.5 + 16.6\log M$$

Where Tm = melting temperature °C
M = ionic strength of solution
See HYPERCHROMICITY.

membrane. 1) A lipid bilayer which separates the internal contents of a cell or organelle from its surroundings. Proteins are distributed at the surfaces or completely traverse the bilayer. Membrane-bound viruses (e.g. RHABDOVIRUSES, MYXOVIRUSES) modify and acquire cell membranes as they mature. 2) Term sometimes used for nitrocellulose or nylon filters used in blotting.

Mengo virus. Family *Picornaviridae*, genus *Cardiovirus*. A virus which is closely related serologically to ENCEPHALOMYOCARDITIS VIRUS of mice.

Mermet virus. Family *Bunyaviridae*, genus *Bunyavirus*. Isolated from birds in Illinois and Texas.

Merodon equestris virus. An unclassified DNA-containing virus isolated from the large narcissus bulb fly, *Merodon equestris* (Syrphidae, Diptera), in France. The elongated rod-shaped particles are composed of a nucleocapsid (650 nm. long) surrounded by an envelope. Infection is characterised by salivary gland enlargement and gonadal atrophy (*see* TSETSE FLY VIRUS).
Amargier, A. *et al.* (1979) C.R. hebd. Acad. Sci. D **289**, 481.

MES. 2-(N-morpholino)-ethane sulphonic acid (mw. 213.3). A biological buffer, pK_a 6.15, with a pH range 5.2-7.2.
Good, N. *et al.* (1966) Biochem. **5**, 467.

Mesoleius 'baculovirus'. A putative NON-OCCLUDED BACULOVIRUS isolated from females of the ichneumonid parasitoid *Mesoleius tenthredinis*. Virus particles consist of a nucleocapsid (65 x 235 nm.) surrounded by one (and sometimes two) unit membrane(s). The DNA genome is circular (mw. *c.*100 x 10^6) and unipartite, as opposed to the multipartite genomes of many viruses isolated from parasitoid Hymenoptera (*see* POLYDNAVIRUS).
Stoltz, D.B. (1981) Canad. J. Microbiol. **27**, 116.

messenger RNA (mRNA). An RNA molecule which is translated by ribosomes to give a protein. By definition it is positive-stranded.

methyl transferase. Enzyme activity found in REOVIRUS particles which is involved in 'CAPPING' of viral mRNAs. Thought to be the product of gene 12 in Reovirus.

methylated bovine serum albumin. Material used as a matrix in the separation of protein molecules by chromatography.

methylation. The addition of methyl groups to nucleic acids. Methylation, by methylase enzymes, of specific nucleotides within the target site of a restriction endonuclease (termed modification) can protect the DNA against cleavage by that enzyme and is the means by which bacteria protect their own DNA against the restriction endonucleases they encode. *See* S-ADENOSYL-L-METHIONINE.

methylene blue. A photoreactive dye which has been used as a vital stain for cells and for the detection of nucleic acids in gel electrophoresis.

MEV. Abbreviation sometimes used to describe the MNPV subtype of NUCLEAR POLYHEDROSIS VIRUSES where the majority of enveloped virions contain more than one nucleocapsid.

mibuna temperate virus. A possible member of the *Cryptovirus* group subgroup A.
Boccardo, G. *et al.* (1987) Adv. Virus Res. **32**, 171.

Michigan alfalfa virus. A *Luteovirus*.
Johnstone, G.R. *et al.* (1984) Neth. J. Plant Path. **90**, 225.

microbial control. The use of micro-organisms and viruses as biological control agents for pests and diseases (e.g. the use of baculoviruses for the control of insect pests).

microbial pesticide. A micro-organism used as a biological control agent for an insect pest (*see* BACULOVIRUS).

microsomes. Fraction of a cell homogenate obtained by ultracentrifugation and comprising ribosomes and fragments (16-150 nm. in diameter) of rough endoplasmic reticulum. Has protein synthetic capacity from run-off of polysomes translating mRNAs.

Microviridae. (Greek 'micro, micros' = small). A family of phages containing a single genus (*MICROVIRUS*) of isometric viruses with a (+)-sense circular ssDNA genome.

Microvirus. ssDNA phages with isometric unenveloped particles (morphotype D1; *see* PHAGE), about 27 nm. in diameter (12 capsomeres T = 1) and knob-like spikes on the vertices. Particles have a mw. of *c.*6.7 x 10^6, sediment at about 114S and have a buoyant density in CsCl of 1.40 g/cc. Virions contain 60 copies of two major structural proteins (mw. 20 x 10^3 and 50 x 10^3) and at least two other protein species. The genome is circular

(+)-sense ssDNA (mw. 1.7 x 10^6). The viruses infect enterobacteria following adsorption to bacterial cell wall receptors. Phage DNA is converted to a circular ds replicative form (RF) by host enzymes. The genome codes for at least nine proteins, some of which are coded for by different reading frames on the same section of the genome. Lysis of the host commences shortly after the appearance of mature phage. The type species is Φx174 PHAGE and the *Microvirus* genus is the only one presently classified within the *Microviridae*. Other members are listed in Appendix F.
Denhardt, D.T. (1977) **In** Comprehensive Virology. Vol. 7. p. 1. ed. H. Fraenkel-Conrat and R.R. Wagner. Plenum Press: New York.
Ritchie, D.A. (1983) **In** Topley & Wilson's Principles of Bacteriology, Virology and Immunity. Vol. 1. p. 177. ed. G. Wilson, A. Miles and M.T. Parker. Edward Arnold: London.

Middelburg virus. Family *Togaviridae*, genus *Alphavirus*. Isolated from mosquitoes in many countries in Africa. Infects sheep.

milk-vetch dwarf virus. A probable *Luteovirus*.
Francki, R.I.B. *et al.* (1985) **In** Atlas of Plant Viruses. Vol. 1. p. 137. CRC Press: Boca Raton, Florida.

milker's node virus. Family *Orthopoxviridae*, subfamily *Chordopoxvirinae*, genus *Parapoxvirus*. Causes red papules on the udders of cows and the hands of milkers. Can be grown in human cell cultures.

millet red leaf virus. A possible *Luteovirus*.
Yu, T.F. *et al.* (1958) Acta Phytopath. Sinica **4**, 1.
Matthews, R.E.F. (1982) Intervirology **17**, 141.

minatitlan virus. Family *Bunyaviridae*, genus *Bunyavirus*. Isolated from a sentinel hamster in Mexico.

minimal essential medium (MEM). A medium for the culture of vertebrate cells. It differs from EAGLE'S MEDIUM mainly in its increased concentration of essential amino acids.
Eagle, H. (1959) Science **130**, 432.

minivirus. A term which has been applied to isometric virus particles (<18nm. in diameter) observed in some insect virus infections, such as crystalline array virus, cloudy wing particle and some putative satellite viruses (e.g. *Antheraea* satellite virus; bee chronic paralysis virus associate).
Longworth, J.F. (1978) Adv. Virus Res. **23**, 103.

mink enteritis virus. Family *Parvoviridae*, genus *Parvovirus*. A virus very similar to feline panleucopenia virus.

minus strand. *See* NEGATIVE-SENSE STRAND 1.

minute virus of canines. *See* CANINE PARVOVIRUS.

minute virus of mice virus. Family *Parvoviridae*, genus *Parvovirus*. A natural and silent infection of mice. Grows when injected into newborn mice, rats and hamsters, causing retarded growth in mice but only a silent infection in rats. Replicates in mouse or rat embryo cell cultures.

Mirabilis mosaic virus. A *Caulimovirus*.
Francki, R.I.B. *et al.* (1985) **In** Atlas of Plant Viruses. Vol. 1. p. 17. CRC Press: Boca Raton, Florida.

Mirim virus. Family *Bunyaviridae*, genus *Bunyavirus* Isolated from sentinel monkeys and from mosquitoes in Brazil.

miscanthus streak virus. A probable *Geminivirus*, subgroup A.
Harrison, B.D. (1985) Ann. Rev. Phytopath. **23**, 55.

Mitchell River virus. Family *Reoviridae*, genus *Orbivirus*. Isolated from mosquitoes in Queensland, Australia. Antibodies found in cattle, wallabies and kangaroos.

mitochondrion. A membrane-surrounded organelle in the cytoplasm of eukaryotic cells. It contains the enzyme systems required for the citric acid cycle, electron transport and oxidative phosphorylation.

mitomycin C. Antitumour antibiotic which is also active against bacteria. It is a selective inhibitor of DNA synthesis. It induces lysogenic phage development as it does not inhibit viral DNA synthesis. Therefore, it is used as a tool for studying viral DNA synthesis in the absence of host cell DNA synthesis.

Mitsuhashi and Maramorosch Medium. A cell-culture medium designed for the propagation of mosquito (Diptera) and leafhopper (Homop-

tera) cells.
Mitsuhashi J. and Maramorosch, K. (1964) Contrib. Boyce Thompson Inst. 22, 435.

MNPV. Synonym: BUNDLE VIRION. Abbreviation used to describe the subtype of NUCLEAR POLYHEDROSIS VIRUSES where the majority of enveloped virions contain more than one nucleocapsid.

mock infection. Inoculation of cells or an organism with a solution not containing virus particles. Used as a control in virus infection experiments to ascertain any possible effects of materials in the inoculum other than infectious particles.

modal length. The most common length of particles in a preparation of a virus with rod-shaped particles. With plant viruses it can be used to distinguish groups of viruses.
Brandes, J. and Wetter, C. (1959) Virology **8**, 99.

Modoc virus. Family *Flaviviridae*, genus *Flavivirus*. Isolated from the deer mouse. Found in several states in Western USA.

Moju virus. Family *Bunyaviridae*, genus *Bunyavirus*. Isolated from sentinel mice, forest rats and mosquitoes in Brazil.

Mokola virus. Family *Rhabdoviridae*, genus *Lyssavirus*. Isolated from children in Nigeria with disease of central nervous system and from shrews. Shrews, mice, dogs and monkeys can be infected experimentally.

molecular radius (M_r). The radius of the space occupied by a molecule. Usually given as relative to the M_r of a hydrogen atom. Considered to be a more correct term for macromolecules than MOLECULAR WEIGHT as it allows for hydration. *See* DALTON.

molecular weight (mw.) (mol.wt.). The sum of the atomic weights of all the atoms in a molecule. *See* DALTON.

molinia streak virus. A possible *Sobemovirus*. Hull, R. (1988) **In** The Plant Viruses. Vol. 3. p. 113. ed. R. Koenig. Plenum Press: New York.

molluscum contagiosum virus. Family *Poxviridae*, subfamily *Chordopoxvirinae*, unassigned to genus. Causes a disease in man which is confined to the skin. Pimples develop into very small nodules, which can persist for several months. Can be grown in WI-38 and human amnion cells.

Moloney leukaemia virus. Family *Retroviridae*, subfamily *Oncovirinae*, genus *Type C Oncovirus*. Isolated from a mouse sarcoma. Produces lymphoid leukaemia experimentally in mice and rats.

Monisarmio virus. Commercial preparation of the nuclear polyhedrosis virus of the Pine Sawfly, *Neodiprion sertifer*, produced by Kemira Oy Co. in Finland, for biological control of the homologous host.

monkey poxvirus. Family *Poxviridae*, subfamily *Chordopoxvirinae*, genus *Orthopoxvirus*. Causes disease similar to that caused by variola virus in monkeys and in man. The disease in man can be fatal. Lesions are produced by inoculation of rabbit skin. Produces pocks on chorioallantoic membrane of eggs and grows in a variety of cell cultures.

Mono Lake virus. Family *Reoviridae*, genus *Orbivirus*. Isolated from ticks in California.

monocistronic. A nucleic acid molecule coding for one CISTRON.

monoclonal antibody. An antibody preparation which contains only a single type of antibody molecule. They are synthesised and secreted by clonal populations of hybrid cells (hybridoma) prepared by the fusion of individual B lymphocyte cells from an immunized animal (usually a mouse or rat) with individual cells from a lymphocytic tumour (e.g. MYELOMA).

monovalent. A term to define the antigenic specificity of a vaccine, e.g. POLIOVIRUS type 1.

Montana myotis leukoencephalitis virus. Family *Flaviviridae*, genus *Flavivirus*. Isolated from a bat in Montana.

MOPS. 3-(N-morpholino)propane sulphonic acid (mw. 209.3). A biological buffer, pK_a 7.20, with a pH range 6.2-8.2.
Good, N. *et al.* (1966) Biochem. **5**, 467.

Morator virus. A genus of viruses (including bee sacbrood virus) established in 1947 in one of the earliest classifications of insect viruses.

Morbillivirus. (Latin 'morbillus' = disease, hence measles.) A genus in the family *Paramyxoviridae*. Contains the viruses causing measles in man, rinderpest in cattle, canine distemper in dogs and peste des petits ruminants in goats. All are very closely related serologically.

Moriche virus. Family *Bunyaviridae*, genus *Bunyavirus*. Isolated from mosquitoes in Trinidad.

Moroccan pepper virus. A *Tombusvirus*.
Fischer, H.U. and Lockhart, B.E.L. (1977) Phytopath. **67**, 1352.
Gallitelli, D. and Russo, M. (1987) J. Phytopath. **119**, 106.
Martelli, G.P. *et al.* (1988) **In** The Plant Viruses. Vol. 3. p.13. ed. R. Koenig. Plenum Press: New York.

morphogenesis. The changes in form during the growth and differentiation of cells and tissue.

morphological subunit. The structural subunit of a virus particle as seen under the ELECTRON MICROSCOPE. These are often clusters of protein subunits (CAPSOMERES) especially in ISOMETRIC particles.

mosaic. A common symptom induced in leaves by some plant virus infections in which there is a pattern of dark green, light green and sometimes chlorotic areas. This pattern is often associated with the distribution of veins in the leaf. In monocotyledonous leaves it shows as stripes.

mosquito iridescent virus. Type species of the CHLORIRIDOVIRUS genus (*Iridoviridae*) isolated from the mosquito, *Aedes taeniorhynchus* (Diptera: Culicidae); originally referred to as insect iridescent virus type 3. Two strains of the virus have been reported; the 'regular' (R) and 'turquoise' (T) strain, the latter appearing spontaneously in a single larva during laboratory studies with the R strain. Virions of the R strain are isometric, *c.* 180 nm. (compared with *c.* 120 nm. for the small iridescent virus, IRIDOVIRUS, group). They sediment at about 4450S with a buoyant density in CsCl of 1.32-1.35 g/cc. Nine structural polypeptides have been detected (mw. 15-98 x 10^3) and the genome is a linear dsDNA (mw. 243 x 10^6). It has been reported that the R strain virion contains two identical DNA molecules. Virus infection probably occurs through cannibalism and by transovarial transmission.
Hall, D.W. (1985) **In** Viral Insecticides for Biological Control. p. 163. ed. K. Maramorosch and K.E. Sherman. Academic Press: New York.

Mossuril virus. Family *Rhabdoviridae*, unassigned to genus. Isolated from mosquitoes in several countries in Africa.

mottle. A diffuse form of the MOSAIC symptom in plant leaves in which the dark and light green are less sharply defined. This term is frequently used interchangeably with mosaic.

Mount Elgon bat virus. Family *Rhabdoviridae*, unassigned to genus. Isolated from a bat in Kenya. Will grow in brains of mice inoculated i.c.

mouse cytomegalovirus. Synonym: MURID BETAHERPESVIRUS 1. Family *Herpesviridae*, subfamily *Betaherpesvirinae*, genus *murine cytomegalovirus group*. Silent infection of wild mice. Young mice can be readily infected, with the virus localising in the salivary glands. Large doses of virus i.p. will kill mice in a few days. Small doses produce hepatitis. Virus can be grown in primary mouse fibroblasts.

mouse encephalomyelitis virus. *See* THEILER'S VIRUS.

mouse hepatitis virus. Family *Coronaviridae*, genus *Coronavirus*. Often causes a silent infection of laboratory mice but it can be activated by passage of other viruses or by other infectious agents, producing hepatitis. Neurotropic strains also exist.

mouse mammary tumour virus. Family *Retroviridae*, subfamily *Oncovirinae*, genus *Type B Oncovirus* group. Causes tumours by transmission in milk. Can be grown in cultures of mammary tumour tissue.

mouse poliovirus. *See* THEILER'S VIRUS.

mouse pox virus. *See* ECTROMELIA VIRUS.

mouse sarcoma virus. Family *Retroviridae*, subfamily *Oncovirinae*, genus *Type C Oncovirus* group. Several strains of virus exist. All rapidly induce sarcomas in mice. They transform fibroblasts in cell culture but do not produce progeny virus unless a helper virus such as mouse leukaemia virus is present.

Mozambique virus. *See* LASSA FEVER VIRUS.

MP variant. *See* MANY POLYHEDRA VARIANT.

M'Poko virus. Family *Bunyaviridae*, genus *Bunyavirus*. Isolated from mosquitoes in Central African Republic.

mRNA. Abbreviation for MESSENGER RNA.

MS2 phage. LEVIVIRUS type species isolated in San Francisco. Virions are unenveloped, 23 nm. in diameter, and probably contain 32 capsomeres arranged in T=3 symmetry. Particles have a mw. of 3.6 x 10^6, sediment at 79-80S, with a buoyant density of 1.46 g/cc. in CsCl. The capsid contains 180 copies of coat protein (129 amino acids) and one copy of 'A protein' (mw. 44 x 10^3). The (+)-sense linear ssRNA is 3569 nucleotides long. MS2 is closely related to other 'group I' leviviruses including phages f2 and R17, though it can be distinguished by serological and other criteria from other groups of structurally-similar phages including Qβ (*see* LEVIVIRUS).
Fiers, W. (1979) **In** Comprehensive Virology. Vol. 13. p. 69. ed. H. Fraenkel-Conrat and R.R. Wagner. Plenum Press: New York.

Mu phage. ('Mu' from 'mutator phage'). A temperate DNA-containing tailed phage (*Myoviridae*) which appears able to integrate at any site on the chromosome of bacterial hosts, thereby destroying bacterial gene functions at the site of integration. The PROPHAGE state is an essential stage in its replication. DNA replication apparently occurs by repeated transpositions to new sites on the host chromosome producing a series of copies of the Mu genome integrated at different sites. It undergoes up to 100 cycles of DNA transposition per hour during the lytic phase of its replication cycle. Maturation occurs with phage DNA excised from chromosomal sites and packaged into virions. The packaged DNA includes short sequences of host DNA at either end of the genome. Because of this method of replication, Mu phage is considered as a TRANSPOSON. A 'Mini-Mu' derivative of the phage DNA, containing the left and right hand ends of the genome, is used as a cloning vector.
Toussaint, A. and Résibois, A. (1983) **In** Mobile Genetic Elements. p. 105. ed. J.A. Shapiro. Academic Press: New York.

Mucambo virus. Family *Togaviridae*, genus *Alphavirus*. Isolated from man, rodents, birds and mosquitoes in Brazil, Trinidad, Surinam and French Guiana. Causes fever with headache and myalgia in man.

mucosal disease virus. Synonym: BOVINE VIRAL DIARRHOEA VIRUS. Family *Togaviridae*, genus *Pestivirus*. Causes mucosal disease with fever, diarrhoea and oral ulceration in several species, including cattle, sheep, pigs, buffaloes, moose and deer. If infection occurs during pregnancy, abortion or foetal abnormality often follows. Virus can be grown in rabbits and in cell cultures. Closely related antigenically to swine fever virus and border disease virus.

Mudjinbarry virus. Family *Reoviridae*, genus *Orbivirus*. Isolated from midges in Northern Territory, Australia. Antibodies have been found in man, wallabies, dingoes and domestic fowl but no disease reported.

mulberry latent virus. A *Carlavirus*.
Francki, R.I.B. *et al.* (1985) **In** Atlas of Plant Viruses. Vol. 2. p. 173. CRC Press: Boca Raton, Florida.

mulberry ringspot virus. A *Nepovirus*.
Tsuchizaki, T. (1975) CMI/AAB Descriptions of Plant Viruses No. 142.
Francki, R.I.B. *et al.* (1985) **In** Atlas of Plant Viruses. Vol. 2. p. 23. CRC Press: Boca Raton, Florida.

multi-hit kinetics. In virology the effect of concentration of a virus in which more than one particle is needed to initiate infection on the number of plaques or lesions induced. It is directly proportional to the $1/n^{th}$ power (where n = number of particles needed for infection) of the concentration of the inoculum. If the viral genome is divided between three particles the number of plaques or lesions will double when six times the concentration of virus is inoculated. *See* ONE-HIT KINETICS.

multicapsid NPV. *See* MNPV.

multicistronic messenger RNA. An mRNA which contains the coding sequences for two or more proteins. Used interchangeably with the term POLYCISTRONIC. *See* OPERON.

multicomponent virus. A virus in which the genome needed for full infection is divided be-

tween two or more particles. The partial genomes in separate particles may have some sequences in common but these are usually in non-coding regions. Examples are COWPEA MOSAIC VIRUS with two particle types and BROME MOSAIC VIRUS with three.
Reijnders, L. (1978) Adv. Virus Res. **23**, 79.
Fulton, R.. (1980) Ann. Rev. Phytopath. **18**, 131.

multigenic messenger RNA. *See* MULTICISTRONIC MESSENGER RNA.

multipartite genome. A viral genome divided between two or more nucleic acid molecules. These may be encapsidated in the same particle e.g. REOVIRUS, ORTHOMYXOVIRUS, or be in separate particles (e.g. COWPEA MOSAIC VIRUS) in which case they are termed MULTICOMPONENT.

multipartite virus. Synonym: MULTICOMPONENT VIRUS.

multiple nucleocapsid nuclear polyhedrosis virus. *See* MNPV.

multiplicity of infection (m.o.i.). Ratio of number of infectious virus particles added to a known number of cells in a culture.

multiplicity reactivation. A form of REASSORTMENT or COMPLEMENTATION between two related viruses which have been INACTIVATED. The sites of inactivation must be in different parts of the genomes of the two viruses.

multiplier prefixes. The table gives multiplier prefixes for basic units:

Prefix	Abbreviation	Multiplier
exa-	E	10^{18}
penta-	P	10^{15}
tera-	T	10^{12}
giga-	G	10^{9}
mega-	M	10^{6}
kilo-	K	10^{3}
hecto-	h	10^{2}*
deka-	da	10^{1}*
deci-	d	10^{-1}*
centi-	c	10^{-2}*
milli-	m	10^{-3}
micro-	μ	10^{-6}
nano-	n	10^{-9}
pico-	p	10^{-12}
fempto-	f	10^{-15}
atto-	a	10^{-18}

* used only as prefixes for metres

multiploid virus. A virus which comprises a population of particles which contain a varying number of genomes (0,1,2,...N), e.g. SENDAI VIRUS, NEWCASTLE DISEASE VIRUS.
Simon, E.H. (1972) Progr. Med. Virol. **14**, 36.

mumps virus. Family *Paramyxoviridae*, genus *Paramyxovirus*. A common infection of man, causing fever and parotitis and less frequently meningoencephalitis, orchitis and pancreatitis. Rhesus monkeys can be infected and show a disease similar to that seen in man. Hamsters, rats and mice can be infected. The virus grows in monkey kidney or human cell lines.

mungbean mottle virus. A possible *Potyvirus*.
Francki, R.I.B. *et al.* (1985) **In** Atlas of Plant Viruses. Vol. 2. p. 183. CRC Press: Boca Raton, Florida.

mungbean yellow mosaic virus. A *Geminivirus*, subgroup B.
Honda, Y. and Ikegami, M. (1986) AAB Descriptions of Plant Viruses No. 323.
Harrison, B.D. (1985) Ann. Rev. Phytopath. **23**, 55.

Murray Valley encephalitis virus. Family *Flaviviridae*, genus *Flavivirus*. Occurs in Australia and New Guinea. Causes fever and sometimes encephalitis in man, often as epidemics. Natural host is probably a bird and the virus is transmitted by mosquitoes. Many species can be infected experimentally i.c., often with encephalitis. The virus can be grown in eggs, producing pocks on the chorioallantoic membrane.

Murutucu virus. Family *Bunyaviridae*, genus *Bunyavirus*. Causes fever in man. Isolated from a sentinel monkey, several rodent species and mosquitoes in Brazil.

mushroom virus 3. Synonym: AGARICUS BISPORUS VIRUS 3.

mushroom virus 4. Synonym: AGARICUS BISPORUS VIRUS 4.

muskmelon vein necrosis virus. A *Carlavirus*.
Francki, R.I.B. *et al.* (1985) **In** Atlas of Plant Viruses. Vol. 2. p. 173. CRC Press: Boca Raton, Florida.

mutagen. An agent which raises the frequency of mutation above the spontaneous rate.

mutant. An individual containing a gene or allele which has undergone mutation and is often expressed in the phenotype.

mutation. An abrupt change in the genotype of an organism not resulting from recombination. In its simplest form it is the substitution of one nucleotide for another leading to changes in the structure of the protein coded for by a nucleotide sequence or modifying gene regulation sequences.

MV-L2 phage. Synonym for L2 PHAGE.

MV-L3 phage. Synonym: L3 PHAGE.

MVL51 phage. Proposed type species of PLECTROVIRUS genus (*Inoviridae*) isolated from *Acholeplasma laidlawii*. Virions are naked bullet-shaped particles (PHAGE morphotype F2) 70-90 nm. long and 13-16 nm. wide, with a buoyant density in CsCl of 1.37 g/cc. The particles contain four structural proteins (mw. 19, 30, 53 and 70 x 10^3). The genome is circular ssDNA (mw. 1.5 x 10^6; 4.5 kb). During replication, infecting viral DNA is converted into a replicative form. The virus is resistant to detergent and ether treatment. The host survives infection; virus particles are extruded through the cell membrane without lysis. Only *A. laidlawii* strains are susceptible to infection by virus particles, though MVL51 DNA will transfect *Mycoplasma gallisepticum*.
Maniloff, J. *et al.* (1982) Intervirology **18**, 177.

Mycogone perniciosa virus (MpV). Probable member of the *Totivirus* group.

mycoplasma virus type 1 phages. Vernacular name for *PLECTROVIRUS*.

mycoplasma virus type 2 phages. Vernacular name for *PLASMAVIRUS*.

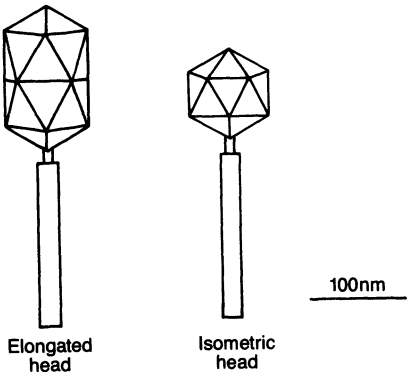
mycoplasmaphages. *See* MYCOPLASMAVIRUSES.

mycoplasmaviruses. Phage-like viruses isolated from mycoplasmas (prokaryotes without cell walls). They include members of the *PODOVIRIDAE* (e.g. L3 phage) as well as the *PLECTROVIRUS* (e.g. MV-L51) and PLASMAVIRUS genera (e.g. MV-L2, renamed L2 phage) and several unclassified isolates.
Maniloff, J. *et al.* (1982) Intervirology **18**, 177.

mycovirus. A virus which replicates in cells of fungi.

myeloma. A tumour of the immune system.

Myoviridae. (Greek 'myos' = muscle). A family of phages with contractile tails (phage morphotypes A1-A3, *see* PHAGE), which contain linear dsDNA that may be circularly-permuted and/or terminally-redundant. The tail is long (80-455



nm.) and complex, consisting of a central tube and a contractile sheath separated from the head by a neck. The family at present contains a single genus (the T-EVEN PHAGE GROUP) and the type species is T2 PHAGE. A large number of phages with these properties have been isolated from bacteria, cyanobacteria and mycoplasmas.
Ackermann, H.W. *et al.* (1984) Intervirology **22**, 181.

Myrobalan latent ringspot virus. A *Nepovirus*.
Dunez, J. *et al.* (1976) CMI/AAB Descriptions of Plant Viruses No. 160.
Francki, R.I.B. *et al.* (1985) **In** Atlas of Plant Viruses. Vol. 2. p. 23. CRC Press: Boca Raton, Florida.

myxoma virus. Family *Poxviridae*, subfamily *Chordopoxvirinae*, genus *Leporipoxvirus*. Isolated from rabbits, hares and squirrels. Exists as a silent infection of rabbits in Uruguay and Brazil. However, when introduced into rabbits in Australia, it caused a severe disease, usually fatal. The virus essentially eliminated the rabbit population in Britain in the 1950s. The signs included inflammation and swelling of the eyelids, nose, genitalia and anus. Transmission is by contact and by insects, mosquitoes and fleas. Virus can be grown in suckling mouse brain and in tissue cultures of cells from many species. Produces pocks on the chorioallantoic membrane.