

The concept of virus species

The species is the basic taxonomic group in biological systematics. The species concept can be extended to virology because viruses are biological entities, not simply chemicals. Viruses have genomes, replicate, evolve, and occupy particular ecological niches. As for all other biological entities, viruses have an intrinsic genetic variability due to the error-prone process of nucleic acid duplication. It is this built-in variability which allows biological systems to become adapted through selection and which in the end guarantees their survival.

Whereas the molecules of a chemical compound are all identical, the virus particles isolated from an infected host have an inherent variability. Hence, unlike chemicals, virus species cannot be grouped into universal classes defined by a single property or set of properties that are both necessary and sufficient for class membership.

Properties and classes are related abstract entities. Whatever is said about a thing is seen as ascribing a property to it, or equivalently, to assign the thing to a universal class [5]. If a virus has a positive strand RNA genome, it is automatically a member of the class of positive strand RNA viruses. In addition, the same virus could also be a member of other universal classes defined for instance by icosahedral shape or a certain genome structure. It is important to realize, however, that although viruses can be members of a variety of universal classes where each such class is defined by a single property both necessary and sufficient for class membership, the grouping known as a virus species is not a universal class definable by a single property. Instead, members of a virus species can be grouped into a different type of class known as a polythetic class, defined by a combination of properties [8, 9]. In a polythetic class, no character or property is necessary or sufficient to define the class. The concept of polythetic class was introduced by Beckner [1] and is illustrated in the following example taken from Sattler [6].

Suppose a group of individuals is defined by a set of five properties, f1 to f5. If these properties are distributed as shown in Table 1, a typical polythetic class is obtained. In this polythetic class, each individual possesses a large number but not all of the properties of the set, each property in the set is possessed by most but not all individuals, and no property is possessed by all individuals.

Table 1. The concept of polythetic class

Individual	Properties of individual				
1	f1	f2	f3	f4	
2	f1	f2	f3		f5
3	f1	f2		f4	f5
4	f1		f3	f4	f5
5		f2	f3	f4	f5

The definition of a virus species as a polythetic class means that all members of the species do not have a single defining property in common that is necessary and sufficient for class membership. It is not appropriate, therefore, to search for an elusive, single property that would define a virus species. It should be stressed that such a hypothetical property would have to be a defining property of the species (i.e., a property that is common and peculiar *only* to members of the species) and not a defining property of a universal class such as a higher category in the classification hierarchy. For instance, properties that belong to all the members of a virus family (such as positive strand RNA genomes in the case of the *Picornaviridae*) are properties that define the family (a universal class) and they cannot be used to define or differentiate individual species within the family. Hence, common properties shared by the members of different species and which are used to construct higher taxa (e.g., families and orders) are not species-defining properties.

Therefore, a virus species is defined as follows: *A virus species is a polythetic class of viruses that constitutes a replicating lineage and occupies a particular ecological niche* [7].

This definition stresses the biological nature of viruses, but avoids any reference to gene pools, found in earlier definitions [3], because many viruses replicate clonally and do not share common gene pools. The definition also includes the notions of genome, biological replication, and natural selection, since the term *replicating lineage* indicates an inherited genealogy extending over many generations and unified by a common descent. The reference to *ecological niche occupancy* in the definition brings in the role played by ecological determinants (e.g., environmental factors such as host, tissue, and vector tropisms) in maintaining species identity.

The above virus *species* definition clarifies the meaning of the species categories used in virus classification. However, it does not provide a set of rules for deciding where the line should be drawn between any two virus species. Diversity in numbers of members and properties between different virus species can be expected because of differences in the numbers and types of properties chosen to define different polythetic classes of virus species. The issue of which diagnostic properties should be used to delineate virus species has been discussed elsewhere [2–4, 7, 8].

References

1. Beckner M (1959) The biological way of thought. Columbia University Press, New York
2. Bishop DHL (1985) The genetic basis for describing viruses as species. *Intervirology* 24: 79–93
3. Kingsbury DW (1985) Species classification problems in virus taxonomy. *Intervirology* 24: 62–70
4. Matthews REF (1983) A critical appraisal of viral taxonomy. CRC Press, Boca Raton, Florida
5. Quine WV (1987) Classes versus properties. In: Quine WV: *Quiddities*. Belknap Press of Harvard University Press, Cambridge
6. Sattler R (1986) *Biophilosophy. Analytical and holistic perspectives*. Springer, Berlin Heidelberg New York Tokyo
7. Van Regenmortel MHV (1989) Applying the species concept to plant viruses. *Arch Virol* 104: 1–17
8. Van Regenmortel MHV (1990) Virus species, a much overlooked but essential concept in virus classification. *Intervirology* 31: 241–254
9. Van Regenmortel MHV (1992) What is a virus? In: Barnett OW (ed) *Potyvirus taxonomy*. *Arch Virol* (in prep)

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Agenda

December 1–4, 1991

Canadian Conjoint Meeting of Medical Microbiology and Infectious Diseases, Quebec City, Canada. *Contact:* Dr. M. A. Chernesky, St. Joseph's Hospital, Regional Virology Laboratory, 50, Charlton Ave., Hamilton, Ontario L8N 4A6, Canada.

December 1–5, 1991

Annual Meeting, American Society of Tropical Medicine and Hygiene, Boston, Massachusetts, U.S.A. Topics: 1. Arbovirus and viral hemorrhagic fever viral taxonomy, molecular biology, vaccines, epidemiology, diagnosis, pathogenesis. 2. Tropical opportunistic infections in HIV-infected patients. *Contact:* American Society of Tropical Medicine and Hygiene, c/o Society and Associations Services Corp., Suite 130, 8000 Westpark Drive, McLean, VA 22102, U.S.A., phone + 703 790 9063, fax + 703 790 1745.

December 2–5, 1991

59th Annual Conjoint Meeting on Infectious Diseases, Laval, Quebec, Canada. *Contact:* Dr. Pierre Payment, Institut Armand-Frappier, P.O. Box 100, Station LDR, Laval, Quebec H7N 4Z3, Canada, phone + 514 687 5010, fax + 514 686 5501.

December 2–6, 1991

International Conference on Virology in the Tropics, Lucknow, India. Symposia on: Epidemiology; Diagnosis of viral diseases: present status and perspectives; Host–virus interactions; Molecular virology and biotechnology; Prevention and control; Selected topics. *Contact:* Prof. Narayan Rishi, Harayana Agricultural University, Hisar 125 004, India, phone + 91 1662 2445, ext. 4203.

December 4–7, 1991

3rd National Congress of Microbiology, Guatemala City, Guatemala. *Contact:* Olga Isabel Valdez, Secretary, Ave. La Reforma 0-63, zone 10, Guatemala City, Guatemala.

January 3–4, 1992

Symposium Viruses and Diarrhoea, Clinical Virology Group with EGRVD, London, England. *Contact:* SGM meetings assistant, Harvest House, 62 London Road, Reading RG1 5AS, U.K., phone + 44 734 861 345.

January 7–9, 1992

Symposium on Virus Interaction at the Cell Surface, Bristol, England. *Contact:* A. Barrett, Department Microbiology, University of Surrey, Guildford GU2 5XH, U.K., phone + 44 483 571 281.

January 7–10, 1992

World Conference on Poliomyelitis and Measles: Vaccines and Immunization, New Delhi, India. *Contact:* Prof. R. G. Marusyk, Secretary-General, ICVO, Provincial Laboratory of Public Health, University of Alberta, Edmonton, Alberta T6G 2J2, Canada, phone + 403 492 8903, fax + 403 492 8984.

January 9–12, 1992

SGM Clinical Virology Symposium: Viruses and Diarrhoea (with EGRVD), London, England. *Contact:* SGM meetings assistant, Harvest House, 62 London Road, Reading RG1 5AS, U.K., phone + 734 861345.

April 5–9, 1992

International Congress on the Management of Infection, RAI Centre, Amsterdam, The Netherlands. *Contact:* Ms. Andrea Francis, Gardiner-Caldwell Communications, The Old Ribbon Mill, Pitt Street Macclesfield, Cheshire SK11 7Pt, U.K., phone + 625 618507, fax + 626 610260.

April 13–15, 1992

Vaccines for Enteric Diseases, Cambridge, England. *Contact:* Butterworth-Heinemann Ltd., Linacre House, Jordan Hill, Oxford OX2 8DP, U.K., phone + 865 310366, fax + 865 310898.

April 21–24, 1992

3rd National Congress of the French Society for Microbiology, Lyon, France. Topics: influenza virus, poliovirus, papilloma, rabies, HIV, RSV and others. *Contact:* Dr. Claude Hannoun, Institut Pasteur, 28 Rue du Dr. Roux, F-75724 Paris Cedex 15, France, phone + 33 45 68 80 00.

June 7–9, 1992

5th UA-UC Conference on Infectious Diseases, Kananakis Village, Alberta, Canada. *Contact:* Dr. Glen Armstrong, Department of Medical Microbiology and Infectious Diseases, The University of Alberta, 1-41 Medical Sciences Building, Edmonton, Alberta T6G 2H7, Canada, phone + 403 492 2303, fax 403 492 7521.

June 7–11, 1992

International Society for Infectious Diseases World Congress, Nairobi, Kenya. *Contact:* Norman R. Stein, ISID, 180 Longwood Ave., Boston, MA 02115, U.S.A., phone + 617 432 2270, fax + 617 731 1541.

June 9–12, 1992

Vith International Symposium World Association of Veterinary Laboratory Diagnosticians, Lyon, France. *Contact:* Dr. Robert Filleton, L.D.A.V.B., 16 Rue du Vienne, B.P. 81, F-43003 Le Puy en Velay Cedex, France, phone + 33 7105 7676, fax + 33 7102 5213.

June 21–24, 1992

7th International Symposium on Infections in the Immunocompromised Host, Boulder, Colorado, U.S.A. *Contact:* Warren C. Snow, P.O. Box 319, Comstock, MI 49041, U.S.A.

July 11–15, 1992

11th Annual Scientific Meeting of the American Society for Virology, Ithaca, New York, U.S.A. *Contact:* Dr. Milton Zaitlin, Department of Plant Pathology, Cornell University, 334 Plant Science Build-

ing, Ithaca, NY 14853-5098, U.S.A., phone + 607 255 3245, fax + 607 255 4471.

July 13–17, 1992

Australian Society for Microbiology and New Zealand Microbiological Society (combined Scientific Meeting), Sydney, Australia. Topics: all aspects of microbiology with concurrent sessions ensuring almost continuous programmes of virology throughout the week. *Contact:* Australian Society for Microbiology Secretariat, GPO Box 128, Sydney, N.S.W. 2001, Australia, phone + 61 2262 2277, fax + 61 2262 2323.

July 27–31, 1992

5th International Congress on Cell Biology, Madrid, Spain. *Contact:* Berta Rebollo, TILISA, C/Londres 39, E-28028 Madrid, Spain, phone + 341 256 2529, fax + 341 361 0844.

August 1–7, 1992

17th International Herpesvirus Workshop, Edinburgh, Scotland. *Contact:* John Subak-Sharpe, Edinburgh Conference Centre, Heriot-Watt University, Riccarton, Edinburgh EH14 4AS, Scotland, phone + 31 449 5111, fax + 31 451 3199.

September 9–13, 1992

International Conference: Drugs of Abuse, Immunomodulation and Disease (AIDS), Tucson, Arizona, U.S.A. *Contact:* Dr. Ronald R. Watson, c/o Alcohol Research Centre, Department of Family and Community Medicine, University of Arizona, Tucson, AZ 85724, U.S.A., phone + 602 626 6001, fax + 602 626 2030.

September 14–18, 1992

5th International Symposium on Coronaviruses, Chantilly France. *Contact:* Hubert Laude, Unité de Virologie et Immunologie Moléculaires, I.N.R.A., F-78352 Jouy-en-Josas Cedex, phone + 33 34 65 21 21, fax + 33 34 65 22 73.

September 15–18, 1992

International Conference on Tick-borne Diseases at the Host-Vector Interface: an Agenda for Research, Minneapolis-St. Paul, Minnesota, U.S.A. *Contact:* Nancy Harvey, Education Development System, 405 Coffey Hall, University of Minnesota, St. Paul, MN 55108, U.S.A., phone + 800 367 5363, fax + 612 625 8215.

September 21–25, 1992

International Symposium “Hundred Years of Virology”, Leningrad, U.S.S.R. Topics: animal and human viruses, hepatitis viruses, viruses of plants and bacteria, ecology of viruses, new approaches for vaccine construction. *Contact:* D. K. Lvov, Academician Director, The D. I. Ivanovsky Institute of Virology, Gamaleya Street 16, 123098 Moscow, U.S.S.R., phone + 95 190 2874, fax + 95 190 7485.

October 1–3, 1992

2nd Symposium on Ruminant Pestiviruses, Annecy, France. *Contact:* Mme. Camu,

Fondation Marcel Mérieux, 55 Route d'Annecy, F-74290 Veyrier-du-Lac, France, phone + 33 50 69 80 80, fax + 33 50 60 19 71.

October 18–25, 1992

7th International Conference on Comparative and Applied Virology, Kananaskis, Alberta, Canada. *Contact:* Prof. R. G. Marusyk, Secretary-General, ICVO, Provincial Laboratory of Public Health, University of Alberta, Edmonton, Alberta T6G 2J2, Canada, phone + 403 492 8903, fax + 403 492 8984.

planned 1993

Annual Meeting of the American Society for Virology, Davis, California, U.S.A.

planned 1996

August 11–16, 1996

10th International Congress of Virology, Jerusalem, Israel.