

Virus nomenclature: consensus versus chaos

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Introduction

A recent, highly polemical contribution to these columns [10] criticized the workings of the International Committee on Taxonomy of Viruses (ICTV) and suggested that the new Rules about the orthography of virus species names approved by ICTV were leading virus nomenclature into chaos. References to receding or impending chaos are frequently made by those who approve [6, 7] or disapprove [10] of the work done by the ICTV on behalf of the world community of virologists.

In his one-sided and unbalanced diatribe against the work of the ICTV, Gibbs [10] raises several issues that need to be answered. We have gauged the opinions of the ICTV Executive Committee and of the ICTV Life Members regarding the various criticisms levelled by Gibbs and summarize the responses below.

Several of the respondents deplored the derogatory tone used by Gibbs to refer to the activities of the ICTV, an organization of which he is a Life Member, and stated that they regard the ICTV as a valuable international body which, in spite of certain organizational concerns, has served virologists well.

1. ICTV has disobeyed its own Rules

Gibbs claims that the ICTV breaks Rule 3.9 of its International Code of Virus Classification and Nomenclature [16], which states that “Existing names of taxa and viruses shall be retained wherever feasible”.

In 1998, the ICTV did indeed amend Rules 36 and 37 of its Code [14], which had stated that species names were not to be italicized and not capitalized, and introduced the new rule 3.40 [16], which states that “Species names are printed in italics and have the first letter of the first word capitalized”.

Gibbs does not like this new Rule and he attacks the ICTV for having introduced it. He not only misrepresents the way in which the change was implemented but also muddles up the very nature of the change. He maintains that the decision to introduce the new Rule was made by the ICTV Executive Committee (EC) in “a rush at the very end of a meeting with the airport taxis waiting outside”. In actual fact, the EC debated the issue at great length and did so in the middle of the day, with no taxis in sight! The EC took the view that since the

names of all virus taxa (genera, families etc), are capitalized and printed in italics, the same typography should be used for the names of species taxa officially recognized by ICTV. After voting in favour of the change, the EC subsequently had the new Rule ratified by the full membership of the ICTV [16, 20].

It is rather disingenuous for Gibbs to claim that ICTV is breaking its Rules: ICTV does not break Rules but amends them following due process. To maintain otherwise is akin to condemning parliaments for changing legislature. Gibbs also misrepresents the nature of the change in orthography by referring to it as a name change. A change in typography or font is not a change in name and it is thus inappropriate to adduce Rule 3.9 in this context and false to claim that ICTV ignored that Rule.

2. Non-latinized binomial names of virus species would be useful but ICTV bans them

Gibbs maintains that ICTV insists that virologists should stop using the informative taxonomy-based non-latinized binomial system (NLBS) of naming viruses. This unofficial system which makes the genus name part of the species name (tobacco mosaic virus becomes tobacco mosaic tobamovirus) was introduced for the first time in the index of the second ICTV Report published in 1976 [8] and has become very popular with plant virologists. Actually, ICTV does not insist that plant virologists stop using this unofficial naming system. ICTV strives to have a single universal naming system for all viruses but since there is no consensus about these names among virologists working in different areas of virology, ICTV has never attempted to enforce the NLBS as an official system applicable to all viruses.

When the issue was debated within the EC, there was a large majority against the proposal that official virus names be replaced by non-latinized binomial names. As recounted in these columns [21], the NLBS has many advantages. When one is not especially conversant with the virus in question, it is indeed helpful to be able to infer from the binomial names that hepatitis A, B and C viruses, for instance, belong to three different genera. Similarly, the names Bluetongue orbivirus and West Nile flavivirus are more informative than Bluetongue virus and West Nile virus.

Gibbs' displeasure with the ICTV rests with the fact that *Tobacco mosaic virus* (genus *Tobamovirus*) is at present the official way to refer to the virus rather than by the condensed form: Tobacco mosaic tobamovirus. This condensed form of the names was used in the indices of the Third and Fourth ICTV Reports [11, 12] for all the viruses to which the system could be applied at the time. In the Fifth ICTV Report [9] the system was retained for indexing plant viruses while in the Sixth Report [19] it was no longer used. That the system is useful and can serve to form unofficial names is beyond a doubt. Many plant virologists have used them in the past and will continue to do so even in the absence of a general consensus that such names should become the official names of virus species. They will not, of course, claim that the NLBS names are official species names and thus they should not write such names in italics.

3. ICTV orthography rules are against currently accepted virological practice

Gibbs claims that the new orthography rule does not follow the ICTV guideline which recommends that any revision to the Code should conform with accepted virological

practice [16]. Although unofficial non-latinized binomial names are indeed popular with plant virologists, there is no consensus about which typography should be used and it is, in fact, unclear what “the accepted virological practice” actually is. In his recent textbook, Bos [2] uses an all Roman version of the NLBS and writes tobacco mosaic tobamovirus. Albouy and Devergne [1] in their book, use full italics with a capital initial, i.e. *Tobacco mosaic tobamovirus*, while Gibbs himself (Brunt et al., 1996) opted for a hybrid typography: half Roman, half-italics, ie Tobacco mosaic *tobamovirus*. Having different authors follow their idiosyncratic preferences does indeed lead to typographic chaos. However, this does not prevent Gibbs from asserting that it is the ICTV which fosters chaos by opting for a uniform, italicized typography for all the taxonomic levels used in virus classification

The use of English for the names of virus species reflects its emergence as the modern *lingua franca* of science. These English names are also used in publications written in other languages and the use of italics then appropriately indicates the alien nature of the term [1]. Italicized English is replacing italicized Latin. The use of italics is also a convenient way to indicate that the term refers to a formal, abstract class (i.e. a taxon such as a genus or a family) and not to concrete objects that replicate and cause disease [21]. Using italics only for ICTV-approved species names also has the advantage that strain names written in Roman are distinguished from species names. The rationale for using italics escapes Gibbs altogether since he contends that italicization was only introduced to draw attention to the ICTV

It is ironic that those who oppose the use of italics for species names in virology [4, 10] insist that italics should be used exclusively to highlight the botanical species component found in a few plant virus names. In the 644 plant virus species listed in the 7th ICTV Report, there are only seven species names that contain a latin host name. In these cases, when the virus species name is italicized, the botanical binomial name is automatically also in italics and one wonders why this is not acceptable. The argument that botanical species italics should not be mixed up with viral species italics rests on the spurious claim that this will increase the precision of reference that is crucial in science [4]. One might well ask what is the point of referring to the taxonomic name of a particular plant host when the same virus infects a large number of different hosts. Furthermore, linking a virus and a disease to the abstract category of a plant taxon is another example of mixing logical categories, whereby abstract notions are confounded with concrete entities, which should be discouraged in viral taxonomy [21].

4. ICTV has become isolated from its broader electorate of virologists and no longer represents their interests

This gratuitous assertion implies that in the past the ICTV was more in tune with its constituency. The sad reality is that the ICTV has always had difficulty polling a representative opinion of virologists world-wide. As remarked already in 1983 [13], very few virologists ever make their views on taxonomic matters known. When polls were conducted in the past by the ICTV, very few of the virologists consulted bothered to answer.

If anything, the claim could be made that ICTV today is in closer contact with the virology community than in the past, mainly because of the extensive efforts made to publicize ICTV activities in the Virology Division News (VDN) pages. The publishers of Archives of Virology very generously provide an unlimited number of these pages for the publication of ICTV material, an offer not forthcoming from other publishers active in

virology. Since 1991, about 500 pages of taxonomic material have appeared in VDN, of which about half have appeared during the last 3 years or so [17]. This has had the effect of displaying ICTV activities as never before.

It may be true that most virologists still show little inclination to read about taxonomic issues. Very few of them seem to care about taxonomy and only when certain changes are introduced, do a few individuals find the time to criticize ICTV decisions. However, it is impossible to ascertain to what extent these individuals represent the silent majority. It is easy for Gibbs to proclaim that he knows the interests of the virological community. The same claim is made by virologists who strongly disagree with his views, for instance on the merits of the NLBS. It is our belief that an organization like the ICTV remains the best option for trying to reach a consensus acceptable to the international community of virologists. The structure and organization of the ICTV, a committee of the Virology Division of the International Union of Microbiological Societies (IUMS) [15], ensures that the various opinions can be expressed and that decisions are endorsed by a majority of duly appointed National Members. The advice extended by Gibbs, that all virologists should ignore the ICTV and its ratified Revised Code, is indeed a neat recipe for chaos and is best dismissed as provocation rather than a serious proposal

5. ICTV classification does not match the probable course of virus evolution and there is excessive splitting in current taxonomy

Views collected from members of the EC and Life Members of ICTV show some variety. Most biologists instinctively look to a classification scheme to reflect the phylogeny of the organisms being classified. Virologists are no exception [18]. Nonetheless, few expect phylogeny from classification in the way that botanists or zoologists do. Most regard the phylogenetic tree at the family level, if tree there be, as unknowable. ICTV is duty-bound to reflect the synthesis of the views of virologists and currently takes a largely pragmatic view of relationships, certainly among most higher taxa.

Indeed, the arrangement and naming of viruses hierarchically is what is required of ICTV by the vast majority of virologists. The use of the NLBS advocated by Gibbs is essentially an overt form of such a hierarchical classification (several species in one genus). Recombination as a mechanism for the evolution of virus genomes obviously creates major problems for a hierarchical classification if some phylogenetic meaning is sought for the groupings proposed. But until a scheme that deals with this is accepted by a substantial majority of virologists, it would be irresponsible of ICTV to move to do other than what it has done. Nonetheless, it might well be worthwhile for ICTV to initiate a Study Group to examine ideas for dealing with recombinational origins of modern viruses.

The issue of excessive splitting in virus taxonomy is seen by some as a problem, but by others as a means to clarification. For some years, ICTV EC has tended towards accepting the views of a Study Group, at least when this has been put with conviction and support. It is hard to see how to do otherwise would not invoke sterner criticisms than those currently leveled.

6. The composition of ICTV bodies is unsatisfactory

The composition of ICTV is determined by its Statutes. These are sanctioned by the Virology Division of IUMS following a vote of the full ICTV. The Statutes are subject to

occasional change and ICTV Executive Committees have worked actively to ensure that membership is representative of the virology community and that Committees' members and Study Group Chairs are changed regularly. The recent amendments to the Statutes [22] illustrate this. It is the experience of several ICTV Executive Committee members that recruitment of able virologists to a taxonomic role is sometimes difficult, and the recent expansion in numbers of Study Groups from 44 to 79 in the last 5 or so years has compounded this problem.

7. ICTV does not allow constructive criticisms

ICTV has no power to silence criticisms. These can, and have been, made in several ways. One is at Plenary sessions of ICTV at the triennial International Congresses of Virology. The EC is aware of the unsatisfactory nature of some recent Plenary sessions. But these have not been much different from those in the more distant past, and the EC has often been forced by Congress logistics to hold them in unhelpful circumstances. Efforts are planned to make the International Congress in Paris in 2002 a change for the better. Another route for criticism is through the pages of Virology Division News. Papers submitted to the Editor are judged for their relevance to the work of ICTV, sometimes by reference to one or more EC colleagues, and if acceptable, are published subject to normal editorial review.

8. ICTV does not use modern lines of communication

An attempt was made in 1998 to establish a web-based network for ICTV business but this foundered because ICTV members felt it was difficult to develop arguments over the Internet. Nevertheless, one taxonomic proposal was voted on in this way. However, since that date, technology has improved and most ICTV members are in favour of developing communication in this way. The ICTV Executive Committee plans to establish "chat-rooms" early in 2001. The ICTV network planned will permit any member (or virologist) to contact any or all parts of the network. It will also be possible to post documents that members (and interested virologists) will have a chance to download, read and comment on. ICTV intends to extend this network to the public at large on a consultative basis but to restrict the decision making process to the nominated and elected members of ICTV, in order to comply with the statutes of ICTV.

9. ICTV abuses its control of the Virology Division News (VDN) section of the Journal

ICTV does not control VDN. The Archives of Virology VDN section is provided by the publisher to the IUMS Virology Division. Because of the volume of taxonomic material being published in VDN, the Editorial Board of Archives of Virology decided to appoint one of the ICTV Executive Committee Secretaries as Editor for VDN. In this position, the scientist appointed is not a delegate of ICTV. However, as ICTV is the only Committee of the Virology Division, it is inevitable that VDN carries mainly ICTV-related matters. These are not all simply ICTV EC-inspired notes [17]. Recent articles in VDN [3, 4, 10] are clear testimony that many different viewpoints can be expressed. And when the current ICTV President is asked by the VDN editor to answer criticisms of ICTV decisions, he answers in the name of the ICTV and not as Editor-in-Chief of the Journal.

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References

1. Albouy J, Devergne J-C (1998) *Maladies à virus des plantes ornementales*. Editions INRA, Paris
2. Bos L (1999a) *Plant viruses, unique and intriguing pathogens – a textbook of plant virology*. Backhuys Publishers, Leiden
3. Bos L (1999b) The naming of viruses: an urgent call to order. *Arch Virol* 144: 631–636
4. Bos L (2000) Structure and typography of virus names. *Arch Virol* 145: 429–432
5. Brunt AA, Crabtree K, Dallwitz MJ, Gibbs AJ, Watson L (1996) *Viruses of Plants*. CAB International, Wallingford
6. Calisher, CH, Horzinek MC, Mayo MA, Ackermann HW, Maniloff J (1995) Sequence analyses and a unifying system of virus taxonomy: consensus via consent. *Arch Virol* 140: 2093–2099
7. Carstens ER (1997) Out of chaos order emerges! *Arch Virol* 142: 2563–2565
8. Fenner F (1976) The classification and nomenclature of viruses. Second Report of the International Committee on Taxonomy of Viruses. *Intervirology* 7: 1–115
9. Francki RIB, Fauquet CM, Knudson DL, Brown F (1991) Classification and Nomenclature of Viruses. Fifth Report of the International Committee on Taxonomy of Viruses. Springer, Wien New York (*Arch Virol* [Suppl] 2)
10. Gibbs AJ (2000) Virus nomenclature descending into chaos. *Arch Virol* 145: 1505–1507
11. Matthews REF (1979) Classification and nomenclature of viruses. Third Report of the International Committee on Taxonomy of Viruses. *Intervirology* 12: 133–296
12. Matthews REF (ed) (1982) Classification and nomenclature of viruses. Fourth Report of the International Committee on Taxonomy of Viruses. *Intervirology* 17: 1–199
13. Matthews REF (1983) The history of virus taxonomy. In: Matthews REF (ed) *A critical appraisal of viral taxonomy*. CRC Press, Boca Raton
14. Mayo MA (1996) Recent revisions of the rules of virus classification and nomenclature. *Arch Virol* 141: 2479–2484
15. Mayo MA, Fauquet CM (2000) The current composition of ICTV. *Arch Virol* 145: 1497–1504
16. Mayo MA, Horzinek M (1998) A revised version of the International Code of Virus Classification and Nomenclature. *Arch Virol* 143: 1645–1654
17. Mayo MA, van Regenmortel MHV (2000) ICTV and the Virology Division News. *Arch Virol* 145 (in press)
18. Murphy FA (1995) Virus taxonomy part I: Introduction to the universal system of virus taxonomy. In Murphy et al. [19]
19. Murphy FA, Fauquet CM, Bishop DHL, Ghabrial SA, Jarvis AW, Martelli GP, Mayo MA, Summers MD (eds) (1995) *Virus Taxonomy. Classification and Nomenclature of Viruses*. Sixth Report of the International Committee on Taxonomy of Viruses. Springer, Wien New York (*Arch Virol* [Suppl] 10)
20. Pringle CR (1999) Editorial – virus nomenclature. *Arch Virol* 144: 1463–1466
21. Van Regenmortel MHV (2000) On the relative merits of italics, Latin and binomial nomenclature in virus taxonomy. *Arch Virol* 145: 433–441
22. Van Regenmortel MHV, Fauquet CM, Bishop DHL, Carstens E, Estes M, Lemon S, Maniloff J, Mayo MA, McGeoch D, Pringle CR, Wickner RB (eds) (2000) *Virus Taxonomy*. Seventh Report of the International Committee on Taxonomy of Viruses. Academic Press, New York San Diego (in press)

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