

Department of Radiation Oncology,
Wayne State University,
Gershenson Radiation Oncology Center,
Harper Hospital, 3990 John R,
Detroit, MI 48201, USA

References

1. J. C. Yanch, R. G. Zamenhof, J. Wierzbicki, Y. Maruyama, in *Progress in Neutron Capture Therapy for Cancer*, B. J. Allen et al., Eds. (Plenum, New York, 1992), pp. 191-194.
2. K. Matalka et al., in *Advances in Neutron Capture Therapy*, A. H. Soloway et al., Eds. (Plenum, New York, 1993), pp. 529-533.
3. J. P. Miller et al., *Nucl. Sci. Appl.* 4, 281 (1991).

Ordering Systems

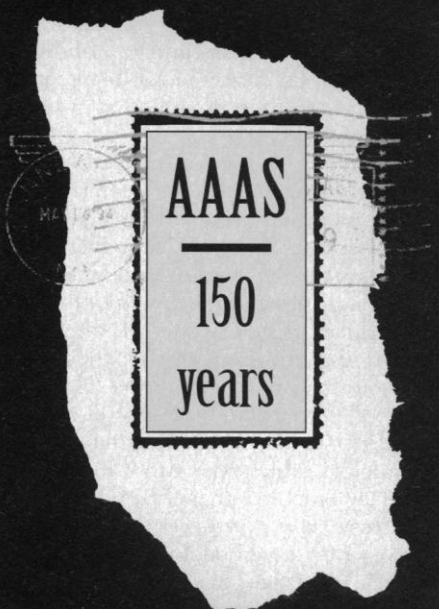
Kevin Padian (Letters, 19 Aug., p. 1017) refers to "Darwinian" and "Linnaean" classifications as if they were the same, and criticizes me for supporting this view. Actually, I have consistently pointed out the total difference between the Darwinian (traditional) and the Linnaean system of classifying. Padian, by implying that the Linnaean and Darwinian systems are the same, ignores the history of taxonomy. It must therefore be stated in a few words.

From Cespino (1583) up to and including Linnaeus, taxonomists applied the downward method of classification, actually a system of identification, as we now realize. In the last third of the 18th century (beginning with M. Adanson), the method of upward classification came into ever greater use and, by the end of the first third of the 19th century, it was the standard method (1). Its weaknesses were that it had no properly articulated method, that it still relied too much on single characters, and that it did not provide an explanation for the grouping of organisms into nearer and more distant relatives. These deficiencies were repaired by Darwin in the brilliant 13th chapter of his *On the Origin of Species*. Here Darwin showed that all classifications must be genealogical in order to reflect his theory of common descent. Furthermore, Darwin strongly emphasized that a second criterion was needed to achieve a sound classification, that of representing degree of similarity (2). Again and again Darwin stated "genealogy alone does not give a classification."

Darwin's advice to base classifications on two criteria, genealogical relationship and degree of similarity, was more or less followed by all good taxonomists in the next 90 years. There was no need to designate this method as Darwinian because it was the only properly presented method of classifying.

After 1950, two new methodologies were proposed, both attempting to base their classifications on only one of Darwin's criteria. The numerical pheneticists (3) said that similarity alone was sufficient. The

Celebrate
150 years
of Scientific Advancement



In 1998, the American Association for the Advancement of Science (AAAS) will celebrate the 150th anniversary of its founding. A commemorative postage stamp would be a fitting tribute to the Association's historic efforts to promote the progress of science and engineering in the service of humankind.

BUT YOUR HELP IS ESSENTIAL.

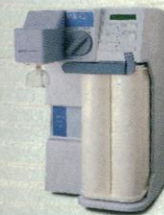
We need letters expressing support for a AAAS commemorative stamp as well as ideas for the stamp's theme and design.

Please write promptly to:

The AAAS Commemorative
Postage Stamp Committee
Office of Communications
Room 801
1333 H Street, NW
Washington, DC 20005
or call: 202-326-6440

Don't
Drown
Your
Data.

Water from conventional ultrapure systems can contain trace levels of ions, pyrogens, and organics that mask peaks in today's sensitive chromatography methods. Protect your data from being swamped with the Milli-Q® TOC Plus. It provides 18 megohm-cm, organic-free (<3 ppb TOC) water and comes with an integral TOC monitor – so you'll know the level of organics in the water prior to running your chromatogram. Keep your data above water with the Milli-Q TOC Plus. For more information, call 1-800-MILLIPORE, ext. 8316. In Europe, fax us at our European headquarters in Paris at 33-1-30.12.71.83.



MILLIPORE



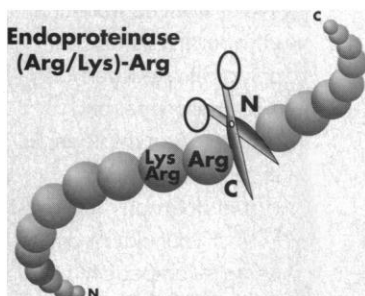
Mo Bi Tec

new site specific

Endoproteinases

Endoproteinase (Arg/Lys)-Arg:

- specific Serine endoproteinase
- cleaves amino acid sequence N-Arg-Arg/-C and N-Lys-Arg/-C at the carboxyl end
- for protein sequencing



Endoproteinase Pro-Pro-Y-Pro (Igase):

- specific endoproteinase
- cleaves very efficiently amino acid sequence N-Pro-Pro/-Y-Pro-C (Y=Pro, Ser or Ala)
- also cleaves in *inclusion bodies*
- for cleavage of fusion proteins made by MoBiTec's PheBo-System
- affinity to PheBo-columns
- natural substrate is IgA1

Endoproteinase Ile-Glu-Gly-Arg (Factor Xa):

- specific Serine endoproteinase
- cleaves amino acid sequence N-Ile-Glu-Gly-Arg/-C at the carboxyl end
- for cleavage of fusion proteins expressed by MoBiTec's pAX-Vector-System

Mo Bi Tec

Wagenstieg 5, D-37077 Göttingen, FRG
Tel: +49 551 37 10 62 Fax: +49 551 34 987
USA, USB Tel. +800-321-9322; +216-765-5000;
Japan, Funkoshi Tel. +03-5684-1620; CH Tel. +56 852831;
GB Tel. +670 732992; NL Tel. +10 4422106;
Ital. Fax +2 48301392; Israel Tel. +2 520092

Circle No. 7 on Readers' Service Card

serious shortcomings of this approach have since been frequently pointed out (4). The other proposed method was that of Hennig (5) who said that one should not classify by establishing groups of organisms by similarity but that one should simply recognize branches of the phylogenetic tree. Again and again in his writings, Hennig warns against using degrees of similarity or difference. Hence, he clearly based his ordering system on one criterion only, that of being on the same branch of the phylogenetic tree. Naturally, species on a given branch have certain characters in common, so-called synapomorphies, and are similar to each other in that respect. However, most branches are highly heterogeneous, and the stem groups of such branches are often far more similar to stem groups of sister taxa than to the crown groups of their own particular branch (clade). Thus Hennig's scheme clearly violates the second of Darwin's criteria. In order to discriminate the methodology which uses two criteria from the newly proposed phenetic and Hennigian systems, it is now necessary to refer to the two-criteria methodology as Darwinian classification. It has, of course, Padian notwithstanding, nothing to do with Linnaean downward classification.

Both Darwinian classifications and Hennigian systems are valid approaches to ordering. If one is only interested in phylogeny, then, by all means, one should use the Hennigian system. But, as Darwin has said so rightly, phylogeny alone does not provide a classification. The Darwinian approach which groups together similar organisms is indispensable for ecological researches, and furthermore, as pointed out by several recent authors (6), it provides more information than the Hennigian ordering system.

Ernst Mayr

Museum of Comparative Zoology,
Harvard University,
Cambridge, MA 02138, USA

References

1. E. Mayr, *The Growth of Biological Thought* (Harvard Univ. Press, Cambridge, MA, 1982), pp. 158-208.
2. C. R. Darwin, *On the Origin of Species* (Murray, London, 1859), p. 420.
3. R. Sokal and P. H. A. Sneath, *Principles of Numerical Taxonomy* (Freeman, London, 1963).
4. E. Mayr and P. Ashlock, *Principles of Systematic Zoology* (McGraw-Hill, New York, 1991), pp. 195-205.
5. W. Hennig, *Phylogenetic Systematics* (Univ. of Illinois Press, Urbana, 1966).
6. K. E. Carpenter, *Syst. Biol.* **42**, 142 (1993); J. J. Sepkoski Jr. and D. C. Kendrick, *Paleobiology* **19**, 168 (1993).

Padian makes the valuable points that Linnaeus' system of classification (1) has nothing to do with Darwin's systematic efforts and therefore that "Hennigian (cladistic)" systems of classification should not be contrasted with something called "Darwinian

(Linnaean)." The record needs to be set straight, however, regarding Padian's argument that Linnaean classification is a vapid formalization of Aristotelian taxonomy with no underlying philosophy. Although Linnaeus' system had long been replaced by better ones by the time Darwin did his taxonomic work (which was much more limited in scope than Linnaeus'), Linnaeus, like Darwin, was interested in the origin of new forms, which is why he became fascinated with hybridization. The problem of finding a natural system, reflecting affinities of genera and orders, occupied Linnaeus already in the 1730s (2). In his *Philosophia botanica* (3), Linnaeus proposed 63 "natural orders" of seed plants, largely corresponding to our families. A diagram [reproduced in (2)] based on lecture notes by one of Linnaeus' pupils depicts the affinities among these orders as perceived by Linnaeus. It is remarkably similar to the phylogenetic trees in cross section popularized by R. Dahlgren and his students in the mid-1970s [for example, (4)]. In the spirit of Aristotelian logic, Linnaeus searched for the essence of a species, for example, in its flower characters, instead of using overall similarity; yet there was room for variation, as we can perceive from the breadth of his species concept and through statements in the *Philosophia botanica* (2). As B. Jonsell has suggested (2), Linnaeus may even have had some influence on the development of modern ideas on evolution through his work on the *Economy of Nature* (5), which discusses warfare (competition) between species. Darwin read Linnaeus, and while *Homo sapiens* L. heads the table in the *Systema Naturae*, he is immediately followed by the monkey.

Susanne Renner

Institut für Spezielle Botanik,
Universität Mainz,
D-55099 Mainz, Germany

References

1. C. Linnaeus, *Systema Naturae* (Leiden, 1735); _____, *Species Plantarum* (Stockholm, 1753).
2. B. Jonsell, *Bot. Not.* **131**, 523 (1978).
3. C. Linnaeus, *Philosophia Botanica* (Stockholm, 1751).
4. R. Dahlgren and H. T. Clifford, *The Monocotyledons: A Comparative Study* (Academic Press, London, 1982).
5. C. Linnaeus, *De Oeconomia Naturae* (Uppsala, 1749).

Corrections and Clarifications

In the article "Genetic testing set for takeoff" by Rachel Nowak (News & Comment, 22 July, p. 464), *Helix* was cited as the source of information for the accompanying table describing genetic testing (p. 466). The information in the table regarding mutational mechanism, cost, and market size came from sources identified by *Helix* who were contacted separately.