

## BOOK REVIEW

**Genera Graminum**, by W. D. Clayton and S. A. Renvoize. Kew Bulletin Additional Series XIII. Her Majesty's Stationery Office, London. 1986. 389 pp. ISBN 0-11-250006-4. £25.00 softcover.

**Grass Genera of the World**, by L. Watson and M. D. Dallwitz. Australian National University, Research School of Biological Sciences, Canberra. 1988. 45 pp., 5 microfiche, and 3 5.25" disks. ISBN 0-7315-0326-0. A\$40.00 softcover.

Grass taxonomy underwent a revolution in the mid-twentieth century, as anatomical and cytological data were incorporated into tribal and subfamilial classifications. Since that time, more and more data have accumulated, particularly on anatomical characters, and an integrated worldwide treatment of the family has become not only possible but highly desirable. These two publications appeared nearly simultaneously, with early versions of the Watson and Dallwitz work appearing in 1985 and 1986. They are reviewed together here because they reflect quite different approaches to the same end.

The *Genera Graminum* represents a classical treatment of the family. It is a compact book, well laid-out and easy to use. The book is divided into two parts: Part I, The Grass Plant, includes sections on morphology, reproduction, anatomy and metabolism, classification, grasslands, and evolution, as well as a brief introduction to the descriptive treatment; Part II is an enumeration of the genera, preceded by a key to the tribes. The synonymy for each subfamily, tribe, and genus is presented, followed by a diagnostic description. One of the great strengths of the book is the nomenclature, which is detailed, complete, and with typification, and will serve as a valuable aid for future taxonomic work on the group. Clayton and Renvoize recognize six subfamilies, a welcome relief for American agrostologists, whose major source for keys has been A. S. Hitchcock's *Manual of the Grasses of the United States*, which uses Robert Brown's original division into only two subfamilies.

The characters used by Clayton and Renvoize are primarily those of gross morphology: habit, inflorescence, spikelet, and floret characters. The "modern" (i.e., micromorphological) characters are given short shrift. Anatomical characters are summarized briefly for each tribe, but there is no way of assessing infratribal variation, even though this is known to be considerable in some tribes (e.g., the Paniceae, which contains both  $C_3$  and  $C_4$  members, members with single and with double bundle sheaths, members with each of the three known decarboxylating enzymes, etc.). This means that using the Clayton and Renvoize treatment for any other analyses is virtually impossible.

A diagram of relationships is presented for the genera of each tribe, and these are already becoming widely used, in part because they are complete. Clayton and Renvoize (p. 23) issue the disclaimer that "the diagrams are intended to



give a visual impression of phenetic relationships, progressing from simple to complex structures; they obviously have phylogenetic implications, but no attempt has been made to treat these rigorously." Unfortunately, I have seen these diagrams used in presentations by agrostologists as if they were phylogenetic. This is the classic problem with nonphylogenetic descriptions of "relationships": authors may know the limitations of their work, but readers persist in interpreting relationships phylogenetically.

I find that the greatest weakness of the book is unfortunately in the rationale for statements of similarity. For example, *Cryptochloa* (Bambusoideae) is said to be "linked to *Olyra* through *O. longifolia*" (p. 63), or *Wangenheimia* (Pooideae) is "related to *Vulpia pectinella*" (p. 97). There is no evidence given for any such statements, and the diagnostic descriptions rarely provide enough information for this reader to make the comparison for herself. This means that anyone who wants to use those observations as the basis for further work must reinvent the wheel—reexamine the specimens, reevaluate the characters, and try to guess the basis for Clayton and Renvoize's assertion—before building on the observations.

Watson and Dallwitz (whose early works are curiously not cited by Clayton and Renvoize) have summarized current knowledge of the genera of the grasses in the form of an automated database. Their publication is thus only 45 pages long and is simply a set of good-quality photographs illustrating the characters used in the descriptions. The generic descriptions themselves are in the microfiche appended to the book. In addition, the publication comes with three floppy disks containing the database and the interactive program INTKEY (an MS-DOS program), used to access the information. The descriptions in the microfiche are complete and parallel, with the majority of the 430 characters described for most of the 761 genera. Characters are both macro- and micro-morphological, and include geographic distribution and number of species. Synonymy is included for each genus, but it is not as detailed as that in Clayton and Renvoize; type species, for example, are not cited.

INTKEY is Dallwitz's development of Pankhurst's ONLINE and is one component of DELTA (the Descriptive Language for Taxonomy), a set of programs written by M. Dallwitz and T. Paine for creating and manipulating a taxonomic database. It functions as a multiple-entry key, thus obviating the need for any other keys in the publication. It is extremely easy to use. Because the database contains so many characters (including geography), identification can be performed rapidly with only fragmentary specimens and frequently without necessitating a lot of detailed knowledge of grass morphology. This is particularly important for a family like the Gramineae, regarded by many botanists as abstruse; identifications can easily be done by nonspecialists.

The database, used in conjunction with INTKEY, is a powerful tool with many helpful features that add up to tremendous flexibility. As one example, it keeps track of which characters are not recorded for particular genera, so the user can distinguish between the character states "not present" and "not known." This is important not only for data analyses, but also as a guide to how well sampled a character is in general, something that is impossible with the diagnostic descriptions of Clayton and Renvoize. Another detail that I have used



extensively in cladistic studies of the family is the ability to choose any set of taxa (e.g., Pooideae of North America) and to summarize the variation within the group for each character. Thus, for example, for character 18 (culm internodes solid or hollow), a single command will be able to tell you that for the particular set of 75 genera, 64 have information on the character, eight have solid stems, and 62 have hollow stems (the fact that the numbers sum to more than 64 indicates that six genera have both hollow- and solid-stemmed species).

I could go on for some paragraphs describing the many useful aspects of the grass database plus INTKEY. Suffice it to say that I have found nothing in book form to compare with it. The data are highly manipulable and are easily updated and corrected. The database contains data amalgamated from the literature and from observations made by Watson and his colleagues. The parts relying heavily on literature surveys can be unreliable, but as the data are used by more and more people for more and more purposes, errors are gradually being corrected. Updating the database is an ongoing process.

Watson and Dallwitz have not included any speculation on the evolutionary history of the family; their classification is the result of a set of phenetic analyses, and the listing of genera assigned to each tribe is printed on the microfiche and also included in the database itself. The classification is not particularly finely resolved, and there is no discussion of possible sister-group relationships—nor indeed of any relationships below the tribal level. This is reasonable in that the authors see the database as a general-purpose tool, to be available for many different sorts of evolutionary and taxonomic studies.

It is an unfortunate characteristic of systematists that more-detailed classifications are preferred over less-resolved ones, even if there is little support for the relationships implied by the detailed classifications. Thus, Clayton and Renvoize are already widely cited for their statements of relationship despite the fact that, as pointed out above, the reasons for these are largely undocumented. It seems that many workers are happy to be able to turn to a book, lift out a diagram, and assume that the relationships illustrated are accurate. The classification provided by Watson and Dallwitz, in fact, goes about as far as the available data allow; for example, neither phenetic nor cladistic analysis of the available data supports tribal divisions in the Chloridoideae, except for the well-marked Pappophoreae and Triodieae.

To conclude, I have found the Watson and Dallwitz publication to be by far the more flexible of the two, and it gives a much better understanding of character distributions. I find its only serious limitation is that some institutions (mine included) do not have appropriate computer hardware in convenient proximity to their grass collection, so the tremendous flexibility of the automated approach is outweighed by the necessity of moving the specimens to the computer. But if one is interested in identifying grasses, or in any sort of data analysis or manipulation, it is clearly the publication of choice. However, for quick reference in the absence of a computer, and for the typification of generic names, I use Clayton and Renvoize. Any herbarium and any agrostologist will probably want to own both of these. Given the total price, it is hard to resist the combination.—E. A. Kellogg, Harvard University Herbaria, 22 Divinity Avenue, Cambridge, Massachusetts 02138.



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