The biology of vines

THE BIOLOGY OF *Vines*

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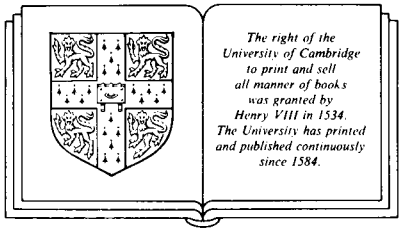

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Foreword

Climbing plants – vines – are one of the most interesting, but also a very neglected group of plants. In the rainforests of the tropics, where they reach their greatest abundance and diversity, they climb into the crowns of tall trees, hang down in gigantic loops and often bind one tree firmly to several others. Their stems reach prodigious lengths and are often thicker than a man's thigh. Botanists have long been familiar with their curious stem anatomy and their varied means of attaching themselves to other plants. They are also of considerable economic importance, both as the most troublesome weeds with which the tropical forester has to contend and as sources of valuable drugs such as curare and strychnine. Though more numerous in the tropics, they are also common in temperate regions: in Britain ivy and traveller's joy are conspicuous features of the landscape as virginia creepers are in North America.

In spite of their varied interest and importance to man, vines have attracted relatively little scientific attention. In the nineteenth century Charles Darwin was fascinated by their structure and behaviour, which he described in his *Movement and habits of climbing plants* (1875). Later Schenck in Germany wrote two classical memoirs dealing mainly with the stem anatomy of climbers (1892–3). Since then no comprehensive work on them has appeared. Research on vines, particularly their general biology, is a conspicuous gap in modern plant science.

Now at last two editors, one a forest ecologist of wide experience, the other an ecological physiologist, have brought together eighteen chapters on aspects of vine biology ranging from photosynthesis and heteroblastic development to breeding systems and effects on other plants, as well as economic and ethnobotany. One chapter deals with the utilization and sylviculture of rattans, a group of climbing palms of great economic importance in the eastern tropics.

Foreword

This book provides access to a large amount of interesting and useful research which has not hitherto been easily available. It will no doubt stimulate much further work and ensure that in the future climbing plants will not be as neglected as they have been in the past. It should be warmly welcomed.

Paul W. Richards
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Preface

Vines are plants that cannot remain free-standing to any appreciable height. There are both herbaceous and woody vines, the latter generally referred to as lianas or lianes. Using 'vines' to denote all climbing plants may initially confuse some readers from lands where, with due respect for wine, 'the vine' is used solely in reference to grapes. Terminological confusion aside, there are still some problems determining what is a vine and what is not. These problems derive from the fact that there is no clear distinction between self-supporting and non-self-supporting plants either ontogenetically or evolutionarily. Most vines do not require external support until they are a decimeter up to a meter or more tall. Under some conditions, normally climbing species seem to thrive in the absence of mechanical support and take on the appearance of rank shrubs or treelets. Some vines simply lean on neighboring plants without displaying any obvious 'adaptations' for climbing other than a tendency towards etiolation.

Although the climbing habit has evolved many times in lineages ranging from ferns and gymnosperms to palms and legumes (see Chapter 1 by A. H. Gentry), most vines share a suite of morphological, anatomical, and physiological characteristics. These shared, and primarily derived, characteristics are the primary focus of this volume but variations among climbing plants are also given due consideration.

It almost goes without saying that vines are long and slender; this simple observation seems to be coupled with distinctive anatomical and biomechanical features of vine stems (considered in Chapter 2 by S. Carlquist and Chapter 3 by F. E. Putz and N. M. Holbrook, respectively) as well as in stem repair mechanisms and xylem hydraulics (see Chapter 4 by J. B. Fisher and F. W. Ewers and Chapter 5 by F. W. Ewers, J. B. Fisher and K. Fichtner). Being long and slender and perhaps the environmental heterogeneity they experience seem to have inclined vines towards displaying profound develop-

mental changes (see Chapter 8 on heteroblasty by D. Lee and J. Richards), but has led to neither uniformity in photosynthetic characteristics (see Chapter 7 by A. Castellanos and Chapter 9 by A. H. Teramura, W. G. Gold and I. N. Forseth), nor in secondary chemistry (see Chapter 10 by M. P. Hegarty, E. E. Hegarty and A. H. Gentry). Although not considered in this book, vine stems do not fare well in fires, perhaps because they are thin and not covered with thick layers of insulating bark and thus heat up rapidly. In regard to temporal patterns in leaf, flower, and fruit production, vines are fairly uniform in some forests and varied in others (see Chapter 14 by P. A. Opler, H. G. Baker and G. W. Frankie). Slender vine stems often support masses of leaves equivalent to those supported by much larger diameter trees but lack the trees' storage capacity; many vines, particularly those from arid environments, have storage tissues below ground in the form of modified stems and roots (see Chapter 6 by H. A. Mooney and B. L. Gartner and Chapter 12 by P. W. Rundel and T. Franklin). Thin vines with large leaf masses might also be constrained by lack of volume in which to include phloem tissue.

In order to climb, vines need to locate and somehow grasp, lean, or hook onto suitable supports. Failure to encounter a trellis leads to the demise of many forest vines. Their chances of success are improved by production of long, leafless leader shoots that circumnutate and tendrils that contract after clasping onto something (see Chapter 13 by E. E. Hegarty and Chapter 11 by E. E. Hegarty and G. Caballé). Vines that can climb up the sides of trees or even buildings with the aid of adventitious roots or adhesive tendrils do not seem constrained by lack of potential supports but nonetheless are rare in many forests for reasons that are not yet apparent.

The study of vine biology is important on economic grounds. Vines are among the most important agricultural and silvicultural weeds (see Chapter 18 by F. E. Putz and Chapter 9 by A. H. Teramura, W. G. Gold and I. N. Forseth). Vines are also of tremendous economic value as sources of pharmaceutical chemicals, fruit, and dyes (see Chapter 16 by O. Phillips); climbing palms provide the rattan canes of commerce (see Chapter 17 by S. F. Siebert).

Much remains to be learned about vines; hopefully this volume will provide a solid foundation upon which future studies will be based. In particular, information on the ecosystem function of vines is lacking. Given their abundance, rapid growth rates, and voluminous leaf production, vines certainly must play important roles in nutrient cycling. Environmental concerns about silvicultural prescriptions calling for vine removal also need to be considered in the light of their potential importance as food and inter-crown pathways for animals. Vines can be a nuisance or a godsend but regardless of your perspective, they are clearly worthy of further study.

Acknowledgements

Many of the chapters in this volume were presented at a symposium held at the Estacion de Biologia Chamela, Jalisco, Mexico. We acknowledge our hosts for providing a stimulating atmosphere with gracious hospitality. Many people have contributed towards the completion of this book but we particularly want to thank Stephen H. Bullock for his efforts in organizing the Chamela meeting, his thoughtful critiques of many of the chapters, and his insights into the biology of vines. This book has also benefitted from input from David Dobbins, Mark Matthews, Miguel Franco, and Javier Peñalosa.