IX. TREE ARCHITECTURE, IN FIELD AND HERBARIUM

Tree architecture, the growth form of woody tropical plants, from lofty 'pagoda' trees to low understorey pachycauls, has captured the imagination of professor and student alike.

Previously many attempts had been made to study the growth form of limited plant groups, but only recently has it been possible to see the wood from the trees as a result of the excellent work by Hallé & Oldeman (1970). This small book is crammed full with a wealth of information and profusely illustrated with clear schematic line drawings, supplemented here and there with photos of the habit of selected plants. The presentation, the clear style, and the excellent drawings offset any problems one might have with the language. The growth form is analysed into a number of architectural models all of which are illustrated. Numerous lists of examples of each model are given; from necessity the lists mainly contain African and South American species, but many families and genera also occur in Malesia. Recently Hallé has visited New Guinea and has published a short account of a selection of his observations (Hallé, 1974). It is regretted that more extensive lists of Malesian examples of each architectural model were not included in this paper. No new architectural models were found so one can, in principle, interpret the architecture of Malesian trees using the models discussed in his book.

A completely different approach to the same subject is that of Tomlinson & Gill (1973), an important introductory paper. The authors consider growth form in terms of apical dominance and control of leaf and branch extension. They draw attention to the presence of 'supernumerary' buds (more preferable is the term serial or multiple buds) at the nodes. The authors note that nothing is known of the distribution and frequency of occurrence of serial or multiple buds in tropical plant families. However, a rapid survey of herbarium material of genera listed by Hallé as having differentiated branch systems with plagiotropic branches indicated that many of these clearly had serial buds.

The presence of serial buds and plagiotropic branches is often associated with branches and inflorescences with a supra-axillary origin from the main axis, a feature more readily seen than the small dormant buds. Tree architecture is a relatively new field of study but one of the most promising lines of investigation seems to be the interpretation of the architecture more in terms of growth form; the specialization of serial buds and differential apical control over these buds. Further documentation of the distribution of serial and multiple buds in the different families and genera

is required together with detailed information as to the mode of specialization of the various buds. It would seem feasible that herbarium and field workers could usefully co-operate on this matter.

In other ways a good basic knowledge of the growth form is important for the herbarium taxonomist. A few examples may be drawn from the Rubiaceae, a family where many genera are known to have plagiotropic branches, mostly classifiable under the models, Petit, Fagerlind, Roux, and Cook. Taxa with such a structure have two serial buds at the node of the orthotropic axis: the upper usually precociously develops into a plagiotropic branch, the lower remains dormant but has the potentiality to develop into an orthotropic lateral branch. The upper serial bud may obligatory develop into a plagiotropic branch or, under flowering stimulus, may develop directly into an inflorescence or a short flowering shoot. The lower serial bud may remain a dormant bud of the orthotropic system or develop into an inflorescence. Frequently small understorey genera have 'lateral' inflorescences embarrassingly variable in the length of the 'peduncles' and in the presence of 'leafy bracts'. Examination usually reveals that these 'lateral' inflorescences have developed from an upper serial bud of the plagiotropic system below which is the dormant bud of the orthotropic system. Under flowering influence these plagiotropic buds have developed directly into a short flowering branch with inflorescences and reduced leaves, lower on the plant inflorescences are borne on a normal leafy plagiotropic branch. Species separated on the 'peduncle' length are clearly without any foundation, several occurring on one plant. It is known that phyllotaxis may differ on the orthotropic and plagiotropic axes, in the Rubiaceae this may be expressed as whorled or ternate on the orthotropic axis and opposite on the plagiotropic axis. Species based on supposed difference in leaf insertion are frequently to be suspected, e.g. Wendlandia ternata is supposed to have ternate leaves but examination shows that this is only true for the orthotropic axis. A further interesting, unresolved example is found in the species of Gaertnera from Ceylon. Gaertnera walkeri, a lowland species, has leaves of both axes arranged in pairs, G. ternifolia, a rare montane species, has leaves of both axes arranged in threes, a supposed hybrid between the two occurs with variable phyllotaxis; that is to say, so far as can be discerned at present, this has the leaves of the orthotropic axis in threes and on the plagiotropic axis paired. A knowledge of growth form immediately suggests that this is an undescribed species. With these few selected examples it can be seen that architecture and growth form are important for the herbarium taxonomist and are not specialized subjects for the field botanist. From herbarium

material it is often possible to feed information back to the field botanist and earmark genera and species where further field studies are required. For example herbarium collections of many Malesian Verbenaceae have supra-axillary shoots and inflorescences associated with the presence of serial buds at the node, but there appears to be no record of these genera conforming to an architectural model with plagiotropic branches. In herbarium material orthotropic apices with lateral branches are but rarely present - mostly in species with small leaves and short plagiotropic branches. Such shoots of larger trees are usually sterile.

Usually one finds what might be compared to temperate 'match-box' series collected by gentlefolk on a leisurely stroll through the Alps - small snippits from the end of a plagiotropic shoot, or more frustrating the plagiotropic branch is pulled off the main axis but in such a way that the structures at the node are absent. Carefully made collections are needed of families with differentiated branch systems, such as: Annonaceae, Apocynaceae, Boraginaceae, Ebenaceae, Euphorbiaceae, Flacourtiaceae, Guttiferae, Icacinaceae, Lecythidaceae, Leguminosae, Loganiaceae, Monimiaceae, Rhizophoraceae, Rubiaceae, Rutaceae, Sterculiaceae, Ulmaceae, in fact from most tropical families. Collections should include the orthotropic leading apex, whether fertile or vegetative, with a field note to that effect, together with sterile plagiotropic shoots. Collections of lower lateral plagiotropic branches should always include the node at the attachment to the main orthotropic axis together with a field note as to length, possible duration, and branching of plagiotropic branch. From such information one can build a picture of the tree from the herbarium specimen, whether it has a monopodial or sympodial trunk, lateral plagiotropic branches which are persistent or deciduous, branched or monopodial. Such collections are urgently needed even for common trees. We have boxes full of Anthocephalus, but of the growth form and attachment of the branches nothing can be discerned. Practice to get one's eye in is easy, go and sit under a young Coffee tree! Better collections (and more stipules) will lead to better taxonomic descriptions, and a greater understanding of the relationships of genera and orders with such a differentiated growth habit. The existence of serial and multiple buds is predominantly a tropical phenomenon, even basic information on their distribution over the families and genera is not precisely known, and even less about the specialization and fate of such buds, it is a wide open, new, exciting field of study. Let us have more careful collections which give more value for money, a sort of tropical family planning in plant collecting.

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THE VIRTUE OF INCONFORMITY

It is refreshing to learn the secret about the potentialities of inconformity for the mighty share of the British in the advance of science from a review of T.Reynolds in Kew Bull. 27 (1972) 215 of the work by D.C.Whitehead on the Role of Nitrogen in Grassland Productivity. He ended the review in saying:

"I was pleased to see that the author has not allowed himself to be brainwashed by metric dogma but has used the proper agricultural units of lb./acre and so on where appropriate. Those lovers of conformity who seek to reduce all units to a scale of ten are robbing us of that versatility which enabled British scientists and inventors to lead the world throughout the various industrial and technological revolutions to which we have been subjected. At school we were bedevilled by problems involving changing Fahrenheit into Centigrade and foot/lb. into ergs but I bet that we learnt a lot more about these quantities than future generations of schoolboys will, who may not have to undergo these mental gymnastics."