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BOTANICAL PROBLEMS FOR THE AMATEUR NATURALIST

BY N. W. SIMMONDS

I am going to spend much of this talk discussing flowering times in plants and I hope to be able to show how the amateur naturalist can assemble really valuable information on this topic. But first let us have some of the facts, so far as they are known.

Before going further afield, let me start with my own garden. Down one side of it I have growing on a tall fence seven vines which show, between them, four distinct flowering behaviours. First there is *Ipomoea learii,* one of the biggest and most handsome of the Morning Glories, which flowers abundantly every morning throughout the year; like the *Ipomoea* (in the sense that they flower steadily) but unlike it (in that they do not flower so abundantly) are *Thunbergia grandiflora, Quisqualis indica* and *Saritaea magnifica;* in general appearance another of the vines, *Phryganocidia corymbosa,* is rather like the *Saritaea* and indeed it belongs to the same family (Bignoniaceae) but it differs markedly in its habits—it flowers in short brilliant bursts of a few days at a time at frequent intervals during the year; *Phryganocidia,* incidentally, is a common woody climber native to Trinidad and may be seen along the Churchill-Roosevelt road. Finally, two of the vines show markedly seasonal behaviour, one of them *(Mucuna rostrata)* flowering magnificently in January and February, the other *(Solandra guttata)* flowering through the wet season, with a peak about November. The *Mucuna* is a Trinidad plant—though I have never seen it in flower in the native state; the *Solandra* is not native, but a close relative *(S. grandiflora)* has rather similar flowering habits and is a conspicuous feature of the wooded limestone country around Tamana and Aripo late in the year.

Other examples of plants which have limited flowering periods readily come to mind, for example: conspicuous Christmas flowers are *Poinsettia* and *Porana paniculata,* the latter a member of the Convolvulaceae but very

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different in general appearance from the Morning Glories. Another example of a plant flowering about this time is so conspicuous that its local name indicates the fact—Christmas bush (*Eupatorium odoratum*, a member of the Compositae or Daisy family).

But seasonal flowering is not confined to the Christmas period of the year for several Bignoniaceae are conspicuously plants that flower at the end of the dry season. Thus, on the I.C.T.A. savanna, we have *Bignonia unguiscati* whose brilliant yellow flowers appearing just before the rain indicate to the students that examinations are approaching and for this reason it is referred to on the savanna as the "Examination Vine"; if flowers only for two or three days. About the same time, the two yellow Pouis also flower and the Trinidad saying that "the Pouis flower three times before the rains" will be familiar to you all. The two species concerned are the Black Poui (*Tabebuia rufescens*) and the Yellow Poui (*T. serratifolia*), of which the former is a small tree the latter a very large one. Now, not all Pouis flower three times every year, for Dr. Herklots tells me that he has seen at least one that flowered four times and I shouldn't be surprised to learn that some trees in some seasons only flowered twice. The fact seems to be that many Bignoniaceae flower in successive bursts on the same inflorescence and that the number of bursts depends on weather in relation to bud development. *Phryganocidia*, the Yellow Pouis, the Pink Poui and *Stenolobium (Tecoma) stans* all seem to be examples of this behaviour.

Now let us, before trying to draw these facts together, look at some observations made in Malaya. Singapore, an island at the southern end of the peninsula, has a somewhat wetter and warmer climate than that of Trinidad, having at most a fortnight or so of dry weather early in the year; further north in the country however the climate is much like that of Trinidad and two wet and two dry periods can normally be distinguished. These differences are reflected, as we shall see, in differences in flowering behaviour of plants grown in the north and south of the peninsula. The examples which we shall discuss are drawn from Holttum's excellent book 'Plant Life in Malaya', perhaps the best book of its kind ever written and one of enormous interest to all naturalists, professional and amateur alike. The Tembusu tree in Singapore (*Fagraea fragrans*) has an abundant and regular flowering each May; the precise time varies a week or two in either direction and is very closely correlated with the occurrence of a week of dry weather in the preceding January. A week's drought early in January brings on flowering correspondingly earlier in May than a drought at the end of the month; when January drought occurs only in short spells of less than a week's duration, then this is reflected in irregular flowering 4 months later. Thus, apparently, drought is the stimulus to flowering in the Tembusu tree and it takes approximately 4 months for it to have its effect. With this species we may contrast another Singapore plant, *Sterculia rubiginosa*, which similarly responds to drought but flowers a mere 2 or 3 weeks later instead of 4 months. Now, while the Tembusu tree and *Sterculia* will respond to as little as a week of dry weather, other species require a much stronger stimulus; so it is that such trees as *Pterocarpus indicus* (the magnificent yellow flowered Angsana), *Erythrina indica* (Dadap) and *Delonix regia* (the Flamboyant) all show, in the seasonal climate of the north of Malaya, a well marked flowering season but in Singapore, with its scarcity of sharp drought, only weak and irregularly distributed flowering periods.

In contrast to the trees which we have just been discussing in whicl flowering seems to be initiated by drought, Holttum describes the exampl of the Pigeon Orchid (*Dendrobium crumenatum.*) In this orchid, severa flowers on an inflorescence develop up to the mature bud stage and remai there until flowering is initiated by a sudden cold day. A cold night is no enough and cold days occur in Singapore only during periods of prolonge heavy rainfall; the temperature drop may be of the order of 10°F., so th word "cold" is used in a purely relative sense. Precisely 9 days later, neithe more nor less, the Pigeon Orchid flowers open just before dawn and clos on the evening of the same day. This means that the Pigeon Orchids flowe simultaneously all over the island of Singapore on the same day and the rest in a flowerless condition until the next prolonged rain storm sets then off again. That both drought and temperature may sometimes be jointl responsible for flowering is indicated by Holttum in the case of the Angsan tree; in this species flower initiation is caused by drought but flowering itsel is triggered off from the mature bud stage by a cool spell.

An example in Trinidad gardens of flower initiation by low temperature is to be found in the Wind Flowers, *Zephyranthes,* so Dr. Herklots tells me Flowering follows about a week after a cool day and the different specie vary slightly (by 1-2 days) in their rate of response.

Now let us try to draw together some of the information we have collecte above. It seems that three main factors are involved in causing plants t come into flower. First we have drought, of which even short periods a quite low intensity may be responsible in some species; in other species, b contrast, longer and more severe drought is necessary and, in any case, there is wide variation from a few weeks to several months in the time taken by the plant to respond. Incidentally, the marked tendency for the Trinidad cocoa crop to come in two lots, one in February and one in the middle of the wet season, probably reflects, at least in part, seasonal flowerings initiated by preceding dry weather. Second, temperature is an important element in causing flowering; quite short spells of cool temperature certainly cause flowering (or, at least, bud opening) in some plants—it is not impossible that warm spells might be equally effective in some species though I know no examples of such a behaviour. It seems that temperature acts, not so much by initiating flowers, as by triggering the opening of buds which are already fully formed. In this connexion it may well be that plants which flower at a definite time of day (for example Morning Glories and the night flowering plants such as the Tuberose, the Night Blooming Cereus and Lady of the Night) are showing a similar but very rapid temperature response by the fully formed buds; but light might well be involved in this problem too. Third in our list of factors affecting flowering time is length of day; it has been known for some years that many temperate plants are highly sensitive to length of day and will flower only during long or lengthening days or short or shortening days as the case may be; quite low light intensities are responsible for the initiation or inhibition and it appears certain that the mechanism is mediated by plant hormones. In the tropics (where variation in day length is less) such behaviours are much less conspicuous but they probably do occur and it may well be that some of the regular Christmas flowering plants flower at that time in response to the comparatively slight shortening of day length that has been occurring during the previous few months. Experiment is badly wanted. As an instance of the contrary process—that is of inhibition of flowering by altered day length—I have in

my garden at the moment two *Ixora* bushes which are flowering on the side distant from the house but flowerless on the side nearest to it; very probably the extra light (even the comparatively weak light from electric light bulbs) is inhibiting flowering on the inner sides of the bushes by effectively increasing day length beyond the level which *Ixora* can tolerate. Contrariwise, Mr. J. S. Campbell tells me that *Gardenia* is stimulated to flower by lengthened days. Since I have a *Gardenia* alongside the *Ixora* by my house, it looks as though I can have flowers on one but not the other unless I arrange an elaborate system of shades and lights!

However, before we can begin really to understand the various factors involved in causing flowering in plants, we must have detailed information on when they do flower; in such information we are surprisingly deficient though Beebe (*Zoologica, 37,* 157) has put some useful data on record. Of particular importance are detailed records of individual plants; for observation of a number of individuals may give the impression that flowering is more or less continuous whereas in fact it may be highly periodic but the periods staggered between individuals in such a fashion as to conceal the underlying periodicity; Holttum gives a good example of this situation by referring to *Delonix regia,* the Flamboyant. Furthermore, detailed records are important so that year-to-year variation in flowering time can be correlated with year-to-year variation in climate; Holttum's interesting results on the Tembusu tree could not have been obtained without the details which enabled him to correlate variation in the incidence of January drought with variation in the time of flowering n May. Now this sort of phenological study is, I think, the ideal investigation for amateur naturalists. No equipment is needed; all that is required is paper, a keen interest and continued attention. I would like to suggest that no more useful work could be done by a group of interested amateurs than to keep a detailed phenological record of,: say, 100 plants for a period of 5 years. The records can be extremely simple. I suggest that the immediate observations could best go down on small pieces of graph paper each one of which would record the data for one plant for one year, the observations could be recorded weekly by means of short vertical lines against the appropriate date, the height of the lines indicating the amount of flowering, etc. It would be a good plan periodically to transfer ths information from the individual protocals on to master sheets which would each record all the information for one plant for the whole period of 5 years. It would be well worth while including observations of flushing and fruiting since both are related to flowering (or at least are usually so related). The occurrence of a deciduous habit could easily be indicated by a special symbol, At the end of the period of five years there would come the task of relating the results to weather during the period— though there is no reason why interim analyses of this factor should not be made. What weather records to consider would take some thought; at first sight, I should say that dry spells and the occurrence of cool sunless days would be most important; no doubt the local weather office could be persuaded to produce a running summary of the essential information if the case were explained to them. I have mentioned above a tentative figure of 100 plants. In this number I would suggest including perhaps 50 species, each one represented on average by two separate plants. Thus some species might be represented by only one plant, others by three or four plants if it seemed important to have replicate records for them. It is, I think important not to rely too much on single plant records when coming to conclusions, for Holttum and others have shown very clearly that there may be considerable variation between individuals of the same

species depending upon site, soil, exposure and so forth. If the 100 plants were split between ten people then the labour involved would not be very great; indeed, all that would be absolutely essential would be a regular weekly round by each one of the observers; doubtless the 100 plants could be so chosen that each observers's ten plants were as near as reasonably possible to his house so that travelling would be reduced to a minimum. But it cannot be overemphasised that regularity and completeness of record is of the utmost importance; it would be far better to study 20 plants really carefully than to compile incomplete records of 100.

Now let us move on to another (though not unrelated) topic. We have so far been considering plants which are broadly independent of their site for flowering; that is, flowering in them is climatically determined. The situation is at least partly different in other ecological circumstances. For example, among the wild aroids of Trinidad, flowering is but little influenced by climate. An exception to this statement is found in *Caladium bicolor,* a tuberous weed of cultivation whose leaves die down in the dry season about the time that flowers are produced; this is doubtless a seasonal drought reaction. The great majority of the aroids, however, flower more or less continuously or else are limited by light intensity independently of season. Most of the aroids are forest dwellers; some, those that have short stems and do not climb much, flower regularly (though perhaps sparsely) in the deep shade of the forest floor—they can be found in flower at any time of the year if sufficient search is made. Contrasted with these are the climbers (mostly species of *Monstera* and *Philodendron*) which may be abundant in the undergrowth of forest but do not flower until the stems have climbed out into the light. This behaviour is so characteristic that, out of the four strongest climbers in the family only one had been collected in flower for the Trinidad Herbarium when I first interested myself in the group some 10 years ago; of the remaining three, one proved to be a species new to science and the two others were respectively new to Trinidad and known only from a single collection. This is an extraordinary state of affairs for four plants that are both common and quite freely flowering; the reason of course is that flowers are formed only in light, exposed places, usually far out of reach of the botanist; they are not difficult to find although they may be very difficult to collect. Another interesting feature of the climbing aroids was their propensity for producing juvenile leaves of form and appearance extraordinarily different from the mature leaves of the same species; it was only after complete series of leaf forms relating juvenile to adult shapes had been collected in the field that some of the bewildering collections in the Trinidad Herbarium could be interpreted. The same sort of variation in leaf and shoot form is characteristic of many climbing plants and would be well worth much more investigation than it has had; as an additional example, the same Ipomoeas which normally have strongly climbing stems bearing deeply cut leaves, may bear ground-running stems with more shallowly lobed leaves.

Among the Trinidad aroids there are also a few true epiphytes—that is, plants that germinate and live entirely on the trunks or branches of trees and have no contact with the ground. These plants, too, are light-demanding and, though they may grow quite well in deep shade, will not flower there. The same sort of situation has been found in the Bromeliaceae by Dr. C. S. Pittendrigh, who showed that members of this family in Trinidad varied widely in their light demands for flowering. An interesting result of these facts is that the epiphyte and climber flora of the Trinidad cocoa plantations

is drawn from among the Araceae and Bromeliaceae which normally live up in the crowns of the dominant trees in the high woods. One can think of the cocoa field, in fact, as an open forest in which high light intensities exist much nearer the ground than in any natural forest, resulting in correspondingly altered vertical distributions of the light-demanding epiphytes and climbers. This fact, incidentally, has had an important impact on human ecology for the Bromeliads are, some of them, breeding places of the Anopheline vectors of malaria; thus, as Dr. Downs has shown, understanding of forest structure is of crucial importance for the understanding of a major human disease.

This leads me on to the other general topic that I want to touch on today. The study of the Trinidad aroids brought home to me very clearly how little we know about the simpler facts of existence of even quite common plants. The same conclusion was reached some 15 years ago by the British Ecological Society who decided that, even in a Flora as well known as that of the British islands, the general biology of the plants was extraordinarily poorly understood. The Society decided therefore to encourage the publication of a work which was to be called the Biological Flora of the British Islands and steady, if unspectacular, progress has been made in this project over the past 13 years. The general plan was this: each species (or sometimes, for convience, each small group of related species) should be studied and written up as a separate biological problem, information on every aspect of life of the plant of conceivable interest to the ecologist being included. Here is the sort of information that is demanded of contributors of the Biological Flora, somewhat modified and simplified to meet our present purposes:

Distribution: both in the island and out of it; even within an island as small as Trinidad many plants are distinctly local in distribution.

Soils: soil preference among plants vary enormously—some weeds are virtually indifferent to soils, growing wherever there is freedom from competition while others (for example many of the savanna plants) are very strictly limited to certain soil types.

Associates: these normally reflect parallel preference for other habitat factors rather than direct association—for example, *Ipomoea pescaprae, Canavalia maritima,* and *Wedelia trilobata* are constantly and characteristically associated on sea beaches and this I take to be a consequence of common tolerance of sandy, wind-swept and salty conditions.

Exposure etc.: some plants will tolerate dry, windswept, hilly sites, others demand sheltered gullies while still others will stand exposure to salty winds on headlands above the sea.

Light and shade demands: these may differ at different stages in the life cycle; light demands for satisfactory vegetative growth may be quite different from those for flowering—the aroids that we have just discussed illustrate this point.

Phenology: time of shoot growth, flowering and fruiting—perhaps to be related to climate, as we have just seen.

Pollination: self-pollination, wind, insects, birds?—there is little information on this subject among tropical plants.

Vital statistics: seed production in relation to life cycle—how many seeds per fruit and per plant and are they viable?

Conditions for germination of seeds:..dormancies are common among the seeds of temperate plants but little work has been done on tropical plants in this connexion—some (perhaps many) tropical plants have the reverse of a dormancy, in the sense that they must germinate at once or die (*e.g.* cocoa).

Distribution of seed: wind, water, animals?—among the last, man is very important for his habit of carrying weed seeds around the world as impurities in agricultural seed samples and for his habit of wearing woollen stockings or long trousers with turn-ups.

Enemies: pests, diseases, other animals?—man is, once again, important for he is certainly the principal enemy of forests and the principal creator of non-natural habitats.

History: a native or an introduced plant or, perhaps, native but still spreading?—some of the Guiana plants known at present only from southwest Trinidad may represent recent colonizers which will yet spread into other parts of the island.

Uses: timber, tans, thatching or plaiting, bush medicine?

I think we can conclude by saying that the amateur contribution to botany can best be made in fields in which specialized equipment and knowledge are not necessary—indeed, may sometimes be a positive hindrance! For this reason I would exclude most experimental studies (except perhaps, simple garden cultivation) and I would also exclude straightforward taxonomy as being unsuitable for the amateur effort. I can think of no approach more suitable for the amateur than what we may call the natural history approach, and, within these limits, no sudies are potentially more productive than those of phenology and general field biology along the lines indicated.

BIRD NOTES FROM THE ARIMA VALLEY, WITH THREE NEW RECORDS FOR TRINIDAD.

D. W. Snow

(New York Zoological Society; Dept. of Tropical Research Contribution No. 982.)

THE following notes are based on only six months' observations, from January 20th to March 3rd 1956, and from March 4th to the end of July 1957. They have been selected either because they appear to be new records for Trinidad, or because records of the species concerned are far from adequate and additional information on their status is worth reporting. For nomenclature I have followed Belcher & Smooker's series of papers in the *Ibis* (1934-1937), the most complete recent account of the birds of Trinidad. Most of the observations have been made near Simla, the New York Zoological Society's Field Station at 800 ft. in the Arima Valley.