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P. F. Hunt

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Orchids of the Solomon Islands

BY P. F. HUNT

Royal Botanic Gardens, Kew

This paper deals very much with generalizations rather than statistically usable facts. The science of orchidology has never attracted many workers, never as many as, say, the fungi or the grasses or the ferns. The orchidologists there are and have been and probably will be are mostly involved with describing new species and relegating to synonymy those species described by their past and present colleagues! There has been very, very little geographical and phylogenetic speculation in the orchids by orchidologists and in our present state of incomplete knowledge, generalizations are all that can be aimed for.

Altogether 350 gatherings of orchids were made during the Expedition and most of these are represented by dried, i.e. pressed, herbarium specimens. For the information of non-botanists, as with the herbarium specimens of other plant families, the great majority of orchids had more than one specimen collected, and the duplicates have been distributed to Herbaria in all parts of the world. In fact at least 17 Herbaria have received some specimens of orchids collected on the Expedition. The usual policy is to distribute only those that are fully identified—otherwise somebody may describe it as new! The great majority of the 350 collected were also preserved in liquid, either as whole plants if these were very small or a sample of the flowers of the larger species. In addition, 130 living plants were sent back to Kew for cultivation such as *Sarcochilus moorei*, which has such a short flowering period, the flowering probably being brought on by a sudden drop in temperature as has been recorded in some Malayan species. About half of these are represented by pressed specimens made at the time of collection, but the remainder were collected only as living plants as they were not flowering at the time. As they flower at Kew they are identified and specimens made. Many have also been photographed and several painted by the official Kew artist for the collection of orchid drawings housed at Kew.

In recording and investigating the orchid flora of the Solomons, and this is taken to include the Santa Cruz group and Bougainville, I also had at my disposal the material collected by the Australian C.S.I.R.O. Expedition to Bougainville in 1964 and that collected by Mr Maurice Mason, the amateur orchid grower and collector from Britain who has made an extensive collection of living plants only in Bougainville, and also the B.S.I.P. Forestry Department's own series (numbered BSIP). Earlier material examined included that collected by the British Museum expedition and by E. S. Brown and the very earliest specimens collected by Guppy, H.M.S. *Penguin*, Rev. Cumins and Im Thurn, the first High Commissioner, who paid frequent visits from Fiji. While I was in the Solomons many useful contacts were made with local orchid growers, many of whom have extensive collections of Solomon orchids, and the previous High Commissioner Sir David Trench's collection still thrives round Government House. Since my return I have received several consignments of orchids from growers and collectors, many of them new records for species and even genera, the latest being a species of *Galeola* which is a scrambling saprophyte

reported to be up to 7 m long, with scale-like leaves and brown flowers; related species occur in the Mascarenes, Asia and Australia, but it has never before been found east of New Guinea. However, this collecting and cultivating, carried out incidentally also by the native Solomon Islanders, could possibly affect inter-island distributions. Some of the Kolombangara coastal species I was told had been brought from New Georgia and Gizo by the native Melanesians and Gilbertese.

Altogether about 230 species are now known to occur in the Solomon Islands and this is just over a 200% increase on the number recorded before the Expedition went there in 1965. These species are distributed among 70 genera although very unevenly. The total orchid flora so far recorded, with regard to the relative number of species per genus, is very similar to that of New Guinea, with such genera as *Bulbophyllum* and *Dendrobium* represented by a considerable proportion of the total number of species. In fact, wherever these two genera occur they are in a great profusion of species. This means that many of the genera are therefore represented by one species only. As far as generic distributions are concerned very few genera appear to terminate their eastern extension in the Solomon Islands except those genera which occur only in New Guinea as well. If any genera reach the Solomons from the Himalayas, for example, they generally reach Fiji and Samoa as well. The exceptions to this rule are *Paphiopedilum*, the lady's slipper orchid, a specimen of *P. violascens* being collected by Maurice Mason in Bougainville and subsequently flowered at Kew, and a tentative, unsubstantiated record of this species from Guadalcanal from Gold Ridge, and a few sarcanthoid genera such as *Thrixspermum*, all of which extend from the Himalayas. It is also interesting to note that some genera which occur in the New Hebrides are also in New Zealand, New Caledonia and/or Fiji but do not reach the Solomons; a good example is *Earina*. Even more interesting is the presence in the Solomons of an endemic species of *Acianthus*, closely related members of which occur in Australia, New Zealand and New Caledonia and with no representation at all in New Guinea, although something fairly similar has recently been found in New Guinea (this emphasizes how much more exploration has to be done before we are really sure of the distributional range of certain species and genera.) Of special interest is the genus *Tropidia* with species in central and south America, and Malesia—and one in the Solomons; and *Epistephium*, a most odd orchid with reticulately veined leaves and calyculus, found in Central and South America with just one species in New Caledonia, but not in the Solomons.

Of the 230 species recorded, about 90 are apparently endemic, and of this number about 70 are species completely new to science and which will be described in due course. However, to determine whether or not these 70 species are truly endemic would involve much more exploration and collecting in the adjacent island groups in which our knowledge, judging by the number of specimens to be found in herbaria, is so very poor. I refer mainly to New Britain, New Ireland and the New Hebrides and I would like to suggest that consideration be given sometime to an expedition to these places and especially the New Hebrides. At least as far as orchids are concerned one could fill in so very many gaps.

In New Guinea there is about an 80% endemism of orchids at the species level: Schlechter's 1912 monograph of the orchids of the then German part of New Guinea listed about 1400 species and over 1000 were new endemics; and a great proportion of the Solomons' endemic species which I am going to describe belong to the most diverse genera

in New Guinea such as *Malaxis*, *Dendrobium* and *Bulbophyllum*, these two latter genera with up to 400 species in New Guinea. When species from these diverse genera, or their ancestors, migrated to the Solomon Islands they very likely diversified when they reached there; they obviously have the capability of considerable diversification and variation as I mentioned just now.

Most of the 20 previously described endemics such as *Dendrobium goldfinchii* and *Cadetia hispida* are reasonably widely distributed and fairly frequently encountered in the Solomons and one would have thought that such obviously tolerant and adaptable species would have been found elsewhere. However, again our poor knowledge of the adjacent islands may be the reason why they have not been recorded elsewhere. In any case, however, all of the apparently true endemics as well as those not yet proved otherwise are closely related to New Guinea species such as *Dendrobium eboracense*, closely related to *D. goldfinchii*, or they belong to genera in which the majority of species are very closely related in any case, as in *Eurycentrum* and *Zeuxine*. No orchids have diverged sufficiently since they have been in the Solomons to form new sections or subsections of a genus let alone a new genus.

Below I mention a little about the features of the orchid family but here I should like to stress only the primary division into epiphytic and terrestrial. The tropics' orchids are mainly epiphytic, and the Solomons well exemplified this, trees at all levels from coastal coconuts and mangroves to summit elfin forest being often festooned with orchids. The epiphytic habit of orchids confers considerable powers of survival in adverse conditions, for example, some orchids I found only at the top of the uppermost branches of fairly tall forest trees, growing and flowering in conditions under which no other epiphytes at all were growing, not even lichens as far as could be seen. The insolation must be very great and wind-speeds quite excessive and yet these plants were obtaining all their supplies of food and water from the air—they obviously require minimum amounts of food for survival and can enter into a state of suspended animation—all of which can enhance their chances of survival in a newly acquired habitat.

Although there is a certain amount of overlapping and a certain number of reasonably ubiquitous species, the epiphytic orchid flora falls into four distinct types depending on habitat; mangrove species, other coastal species, rain-forest species and those characteristic of the highest altitudes. Each of these groups has a distinct floristic composition and to a certain extent this appears related to the species geographical relationship. The upper montane, the mangrove and the other coastal species are usually found also outside the Solomons, but the true rain-forest species contain a much higher proportion of endemics—both true endemics and those not proven. For example, *Dendrobium sophronites* was found more or less at the summit of Mt Popomanaseu but is identical with material collected from similar altitudes and habitats in New Guinea—and in fact the species even shows the same range of colour variation of its flowers in both countries. Other upper montane species found in both countries are *Dendrobium aemulans* and *D. scarlatinum*; and among mangrove species, often in New Guinea and Fiji are *Robiquetia mooreana*, *Liparis disticha*, *Bulbophyllum sessile* and *Dendrobium spectabile*. However, nearly all my undescribed endemics were from the true rain forest, and included species of *Dendrobium*, *Bulbophyllum*, *Malaxis* and *Glossorhyncha*, etc.

About 80 species, that is approximately one-third of the total, are found in New Guinea and the Solomons only and about 10 in either/or New Guinea, New Ireland, New Britain or adjacent groups. If the correct habitats were available, the Solomons having a very restricted variety of ecological niches for orchids and only a limited altitudinal range and everywhere reasonably near the sea, I feel that many more of the New Guinea orchid flora would be represented, either as the same species or closely related derivatives. This is especially true as regards the terrestrial species—only forest floor and cleared garden land being available in the Solomons—New Guinea and Fiji having a greater proportion of non-forest covered land. There are no orchids in the Honiara grasslands but this is probably because the species are not available rather than the effects of past burning.

There are approximately 20 species which occur also in Fiji but these are mainly more Pacific species that occur also in Samoa and possibly the New Hebrides and other Pacific groups. The remainder of our species are widespread with distributions often from Africa, Madagascar and the Mascarenes, usually through mainland Asia, to New Guinea, Solomons, occasionally north Queensland, Fiji and beyond, often to Samoa. Examples would include such species as *Calanthe triplicata*, *Cirrhopetalum gracillimum* and *Ephemerantha comata*, although none of these are found in Africa. I should like to emphasize here that one of the great values of this type of expedition is not necessarily the contribution towards knowledge which has undoubtedly resulted, but the way in which one has to search the herbaria and literature in an endeavour to identify one's finds and especially to determine their relationships and total geographical distribution. During my study of the orchids I collected I was rather disturbed by the seemingly large number of endemic species in each Pacific and Malesian island. It is only in the last 30 years or less that, in orchidology at least, have taxonomists really considered there to be a sizeable number of widespread species at all. Many needless endemic species were described; in many the differences quoted were of a very minor character, decidedly not of specific status, but always they were reinforced by remarks about being distinct species as they were on different and often distant islands! Much more correlation needs to be done before one has a true picture of orchid species' distributions in the area—and I daresay this applies to other plants as well.

The orchids of the Solomon Islands therefore can be seen to be composed of a variety of elements, 40 % endemic, 1 % palaeotropical, 12 % general tropical Asiatic, 40 % eastern Malesian and 8 % Pacific, but no completely pantropical species: our problem is to decide how they got there. The position with orchids is complicated in that there are no fossil records at all and all theories of time of origin and migration have to be based on supposition, and I would hesitate to suggest any geological time at which any orchid migrations took place or were terminated.

The problem of the origin of the orchids of the Solomons is really at two levels—the global and the local. One has to decide first of all how the orchid flora reached the general south-east Asian area—and then postulate how these species then reached the Solomons. It is rather outside the scope of this paper to do more than briefly generalize on the global aspect. Despite certain zoological evidence quoted in opposition to the theory that a land mass once existed connecting south-east Africa, Madagascar and the Indian subcontinent, the pattern of distribution of some orchid genera such as *Disperis*, *Acampe*, *Nervilia* and *Oberonia* for example, seems to suggest that this land-bridge, called *Lemuria*, could have

existed although not necessarily as a continuous mass, and could have been used as a dispersal route. From the available palaeoclimatic and geological evidence a route via north-east Africa and Arabia seems not very likely at any era. The two Solomon Islands species *Eulophidium pulchrum* and *Liparis caespitosa* could have reached eastern Malesia via this postulated land connection—their present-day range is from Africa, through Madagascar and the Mascarenes, through tropical Asia and Malesia to the Solomons and Fiji—each species gathering incidentally about a dozen synonyms in the process. You will notice that I said they reached Malesia and not they reached Africa via this route. At least as far as the *Eulophidium* is concerned it is almost certain that it came eastwards as Madagascar is the centre of *Eulophidium* speciation, as it is with many other orchids, and they have extended mainly into Africa except this one that went eastwards and another, *Eulophidium maculatum* that went westwards and is now found also in Brazil. However, it is also more or less certain that this route via the Mascarenes also operated in the other direction; the genera *Acampe* and *Oberonia* are both represented by only one species each in tropical Africa but occur in considerable diversity and number in South-east Asia.

Other eastern Malesian species or their ancestors probably travelled from the other great centre of orchid speciation, the Himalayas; some would have travelled from Borneo and the Philippines and others evolved more or less in situ in New Guinea.

Thus we probably had, in the past, a diverse and rich orchid flora hovering to the west of the Solomons archipelago, waiting to be dispersed and waiting for the correct habitats to become available.

As regards local distribution, one can do more than just postulate as there are concrete facts to consider. However, to introduce this aspect a few words should be given about the orchid family for readers who are not familiar with it.

There is a great diversity in the orchid family and, although the basic structure remains remarkably the same throughout the 17 000 species in about 750 genera so far described, the variations on the basic theme are quite fantastic in many cases yet most seem to have some meaning behind them, as the pollinating agent—whether it is an insect or a bird—is usually fairly specific and one has to assume that the orchid and the agent evolved simultaneously, at least as far as insects are concerned. Current work on the specificity of pollinating agents of orchids would suggest this to be the case at least as far as other orchids are concerned but they probably pollinate flowers of other families however, and the birds are probably visiting a great range of flowers. The New Guinea and Bougainville *Dendrobium lawesii*, for example, is pollinated by a red-breasted honey eater. It is more or less impossible in the Orchidaceae to define primitive groups at least within the subfamily Orchidoideae which accounts for 99 % of the species. So many species exhibit features some of which we regard as primitive, others as advanced, but perhaps the entomologist could help here in deciding the primitiveness or otherwise of the pollinator. Orchid seeds are the smallest seeds in the world, are completely devoid of endosperm and often composed of only 16 cells, and cannot necessarily travel over long distances without being affected by the atmosphere; they desiccate very quickly in dry air, yet excessive rain would cause them to be deposited prematurely, perhaps before land was reached if they were being carried over the ocean; they lose their viability in salt water and the digestive juices of birds soon put paid to them. As well as this, for germination the orchids need certain

mycorrhizal fungi and, in fact, they need this throughout their life history. The habitats of orchids are also very specialized, the majority of the Solomon Island species being epiphytes and any migrating seeds have therefore to be deposited on the bark of a suitable tree and the seed must be lodged in a crevice for a suitable length of time for germination to occur and not be washed away with frequent rains. Furthermore, the germination of orchid seeds is itself a very long process, taking six or seven months or more. Added to this, if the orchid is really to be considered as arrived, it must also become established and start to spread in its new environment. It occasionally does this vegetatively but it is more usually carried out by seed—but to produce seed it obviously needs its pollinating agent. Another problem again appears, namely, does the pollinating agent follow its 'host'—very unlikely—or does the orchid find another pollinating agent in the habitat to which it has relatively recently migrated. Orchid plants are very long lived, especially for non-woody plants, and their flowers can last a considerable time if they are not pollinated or if their pollen masses or pollinia are not removed. Individual flowers on an inflorescence will last over 6 months in some species. These two aspects of longevity greatly increase the possibility of a potential pollinating agent finding a recent, relatively speaking, arrival. The new agent may already be in the new locality but pollinating or at least visiting the flowers of another species probably in another family, as I mentioned above.

Some orchids have solved the problem and are either cleistogamous or self-pollinated if no agent is forthcoming in a reasonable period, but I have no evidence of this occurring in native Solomon Island species.

However, it appears that a potential migrant is in for a very tough time when it lands in its new locality. To overcome these multiple hazards in which it would seem that no species ever had a chance of spreading more than a few yards the orchids have evolved a very efficient seed production and it has been estimated that a single capsule may contain up to four million or even more seeds. The total seed production of a colony of epiphytic orchids, each with several multi-flowered inflorescences, must be very large indeed, and when one considers the time over which orchids have obviously been in existence to enable them to evolve their great variability, the chances of a species successfully migrating and establishing itself is reasonably high, although, of course, for this to produce a colony is dependent on its pollinator also arriving and locating its host.

The terrestrial species also have often a good method of seed production. An outstanding example is *Spathoglottis plicata*, a species widespread throughout Malesia, the Philippines, New Guinea, Solomons, Fiji and generally on most Pacific Islands. Most terrestrial orchids in the Malesian region are forest dwellers but *Spathoglottis plicata* is more of a coastal species and also occurs in such unlikely orchid habitats as occupied or derelict villages and in coconut plantations. With it, the inflorescence continues to produce new flowers even after the older ones have formed capsules and subsequently dehisced and liberated their seeds.

However, the shorter the ocean hop the greater the chance of orchids becoming established on a new island because of the greater number of seeds reaching the island and germinating. One would think that a hop of 40 miles would be quite feasible but as far as I know no observations have been made. Wind directions have also to be considered as they would have a marked influence on the aerial transit of such a light object as an orchid seed.

The sudden occurrences of *Orchis purpurea* in Oxfordshire almost 70 miles from its nearest known area, *O. militaris* in Suffolk 50 miles from the Chilterns and *Liparis loeselii* in Branton Burrows with the nearest locality the other side of the Bristol Channel, in Glamorgan, to take known examples nearer home, can all probably be explained by seed migration and consequent establishment. Few islands of the Protectorate lie more than 40 miles from another but, of course, the Santa Cruz group is much more distant. But again they lie within 100 miles of the New Hebrides and the Solomons—from the little we know of their orchid flora, however, their restricted range of niches has restricted the number of species.

Certain former land connexions can be postulated, and it is well known and has already been shown by the zoologists that only a minor fall in sea level, say about 30 fathoms, would expose a considerable area of land extending from Bougainville to Nggela and a lesser drop would expose at least a few more islands.

Therefore one can postulate that the orchid flora reached the Solomons mainly from the New Guinea region and probably via New Britain or possibly the Louisiades, primarily by a series of perfectly feasible island hops and aided by larger continuous land-masses than are present today or at least aided by a greater number of contiguous islands. Once the orchids arrived in the Solomons—it should not really be past tense as they are almost certainly still arriving—they spread to each island by the same dispersal method. Provided their pollination mechanisms were brought into action eventually, they established themselves and depending on their innate genetical ability either diversified and evolved or remained identical to their parents.

There appeared from the relative meagre evidence available to be no great differences between the orchid floras of the different islands we visited—insofar as the availability of habitats allowed. The smallest islands had just as rich a coastal orchid flora as the larger islands but, of course, the more higher altitude species were not present. There is, incidentally, no proof or evidence yet that the San Cristobal orchid flora is distinct, but from the very little information there is about Rennel and Bellona orchids they are considerably distinct being often larger flowered species.

To conclude, there is just one more point where orchids appear to differ from some other plants and from animals: closely related species *can* live together, apparently quite amicably, in very close juxtaposition—there is no excluding. On more than one occasion I noted two or even three closely related species, usually *Bulbophyllums*, growing epiphytically on the same branch, with their almost identical vegetative parts intermingled—separation being only possible on a floristic basis usually when the plants flowered at Kew subsequently. The Solomons are still far from being saturated with orchids—as new species evolve, either in the Solomons or in New Guinea, there is always the possibility they will migrate—and always a chance they will become established and further enrich the flora—but now we should watch out for new arrivals and note their spread and note their pollinators—in other words we must continue to study the orchid flora of the Solomons.