Epiphytic myrmecophytes

of southern Asia and the southwest Pacific

Xerophilia

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Epiphytic myrmecophytes of southern Asia and the southwest Pacific

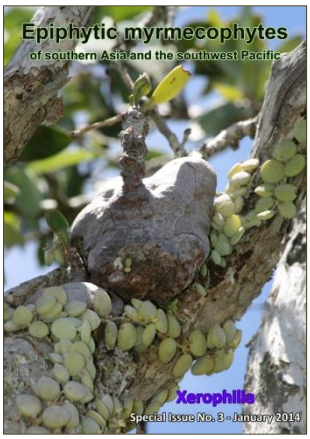
by Derrick J. Rowe, New Zealand

EDITORIAL

We have the great pleasure to be the first to publish on the "free knowledge sharing" segment such an extensive account on myrmecophytes written and illustrated by the New Zealander Derrick J. Rowe. Myrmecophytes (commonly named ant-plants) are plants living in a mutualistic association with ant colonies and cover a far-reaching range of plants belonging to different plant families. As myrmecophytes are virtually unknown to the average cactus, succulent and xerophyte plants collector we hope this will be just a first contact with this peculiar category of vegetation, arousing the passion and the interest for many collectors fascinated by weird or unusual plants. Derrick – who is one of the very few specialists and authors on the subject – has already published his own DVD book back in 2010, entitled "***Ant-plants: Arboreal Wonders of Nature***", and co-authored with Attila Kapitany "***Australian ant-plants: amazing relationships with insects***" in 2012. Derrick also wrote over the last few years several articles on the subject for prestigious printed and online magazines and journals worldwide. This paper covers the basic biology of these pretty much unknown plants, and will explore few hot spots where these weird and often extremely spectacular florae grow: Fiji, Australia and various regions of Papua New Guinea (New Britain Island, Bougainville Island, the Central Province, and the Highlands). Prepare yourself for an informative feast and a pictorial delight.

Eduart

Editing, graphic layout and Romanian abstract for this special issue - Eduart Zimer



Front cover: ***Myrmecodia beccarii***
(Photo by Derrick J. Rowe)

Back cover: ***Myrmecodia tuberosa***
(Photo by Derrick J. Rowe)

Xerophilia

The passion for cacti and other succulents

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Articles and other contributions, photos or other materials are always welcome! Please send them to the email address below. The Editorial Team will examine them carefully and decide on publication in one of the upcoming issues. The next issue is scheduled to appear on March 30, 2014.

xerophilia@xerophilia.ro

Epiphytic myrmecophytes of southern Asia and the southwest Pacific

by Derrick J. Rowe, Kopu, Coromandel Peninsula, New Zealand

Summary

Fig. 1 - *Myrmecodia beccarii* (southern form) with the Onion orchid *Dendrobium* (*Cepobaculum*) *tattonianum*, Hinchinbrook Channel swamps, North Queensland, Australia.

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Part one, an introduction.

Before we start to explore the often weird and wonderful world of these plants in some detail, it will help to refresh a little basic biology concerning the subjects of these chapters.

Epiphytes are of course plants that perch on other plants especially forest trees; they do this primarily for room in which to live but consequently to gain better access to sunlight, both being in short supply on forest floors. The most common epiphytes in temperate latitude forests are non vascular plants such as mosses, liverworts and hornworts but these along with the life forms that constitute lichens are outside the extent of these notes. However, in sufficiently moist tropical and sub tropical forests, vascular (higher) plants, those that possess water-conducting tubes, usually reverse this situation. In these habitats higher plants such as ferns, fern allies and all flowering species often outnumber simple plants, certainly so outside of mossy tropical cloud forests. It follows that tropical and sub tropical forest habitats become our prime focus here.

Fig. 2 & 3 - Fire prone savannahs like these on Cape York Peninsula, North Queensland, Australia, support no epiphytes but enormous termite mounds. // A *Myrmecodia schlechteri* subsp. *schlechteri* var. *schlechteri* colony growing in exposed and typically pendent positions above Kundiawa on the road to Kegsugl and Mt. Wilhelm, Simbu Province, Papua New Guinea.

Arboreal positions certainly help plants to attain species-suitable light levels but they consequently have other problems such as zero access to soil moisture reserves and its nutrients. Hence, this restricts the majority of vascular plants to the far more beneficial habitats created under sufficiently dense and moist rainforest canopies. Without doubt, epiphytes are enormously less common in the widespread trees of drier savannahs. For example in Australia, one may travel for hundreds of kilometres through fire prone open canopies without seeing any epiphytes except for a very few extremely specialised and very xerophytically hardy species.

Suitably dense forest canopies inherently provide shade from too much sunlight and heat as well as supplying regular humidity. These vital environmental factors enable epiphytes to survive the many droughts induced by their habitat's intermittent rainfalls especially in tropical dry seasons. Perhaps surprisingly, dry bark (or soil) has a far greater dehydrating effect on plant roots than a dry atmosphere. (Benzing, 1990) Indeed, many terrestrial succulents allow their roots to shrink during drought, so that layers of air help to protect themselves from further water loss.

Another vital benefit afforded by sufficiently dense and moist forest canopies is the constant throughfall of organic detritus derived from both plant and animal inhabitants. Throughfall creates humus layers, the canopy soils of biologists, that becomes decimetres thick on suitably inclined branches and especially so in tree forks. Indeed, canopy soils can be a better nutrient resource than rainforest soils below, especially when they are part provided by air-epiphytes that are able to glean nutrients directly from the atmosphere. However, air-plant epiphytes are often assisted in this role by symbiotic (close living) nitrogen fixing microflora.

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Fig. 4 - *Grammatophyllum scriptum* in flower near Kieta, central east Bougainville Island, Solomon Islands. Here perched on a Coconut tree, a site with very little through fall opportunities.

Various fern species are particularly notable for adaptations that enable the retaining of throughfall; hence, they are able to store their very own reserves of canopy soils. Not only do humus accumulations supply nutrients as its varied detrivore (humus eating) inhabitant's catabolise it, but by absorbing rainfall, it can also act as small water reservoirs.

Varied life forms utilise or make their homes in impounded humus and all help to feed host plants with their wastes. Furthermore, humus-impounding plants often have close relationships with ant colonies but these are frequently of an opportunist nature, with ant defence being an important driving force. *Drynaria* ferns for example have 'honey' producing nectaries, surely intended to encourage protective ant species to remain close. Nevertheless, it follows that humus-impounding epiphytes need leafy vegetation above.

Humus impounding strategies are not restricted to ferns. For example, the upward pointing root masses of xerophytic *Grammatophyllum* orchids catch throughfall but perhaps the greatest benefit of their “thrash basket” root masses is that ants often nest among them with nutrient-rich colony wastes helping to feed host plants. That this is a useful survival strategy is shown by this genera's ability to survive in habitats often far too high and exposed for most other epiphytes, hence severely reducing competition for living space.

Evidence that this survival strategy is beneficial is provided by the following species. *Grammatophyllum multiflorum* has a nine-month flowering period being one of the longest-blooming orchids known. *G. speciosum* is recorded as the largest orchid in the world. A specimen weighing two tons was a highlight of the world-famous exhibition at the Crystal Palace, London back in 1851. Both examples require abundant nutrient resources. Grammatophyllum speciosum

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Fig. 5 & 6 - An ant-house *Dischidia* species grows near the root mass of a *Grammatophyllum scriptum* in the lowlands near Kieta, Bougainville Island, northern Solomon Islands. Here we have hints of the far more complex myrmecophyte guilds seen in North Queensland, Australia and particularly common in New Guinea. // *Grammatophyllum elegans* growing in a typical highly exposed position on the dry side of Taveuni Island, Fiji. This lone host tree was fully exposed to trade winds, tropical cyclones and salinity off the nearby Ocean. Above it in a most improbable position for the species habitat is a humus impounding fern *Asplenium australasicum*. It is almost certainly surviving here because of its nearness to the myrmecophyte orchid.

This subject brings us to a second key word in this article's title, which is "myrmecophytes" a label that translates from Latin as ant-plants. Using the word myrmecophyte rather than ant plants in pertinent literature should be encouraged. If I am not believed, try Googling for ant-plants.

Myrmecophytes are plants that form symbiotic relationships with ant colonies. Probably the most studied examples are terrestrial trees of the Americas and Africa but again these are outside the span of these notes, so back to the orchids. See also: Myrmecophyte

Although more field studies are needed, there is emerging evidence that myrmecophytic orchids have particularly large inflorescences in relation to their orchid peers and are usually quite xerophytic. Ants typically prefer warm sunny sites; therefore, such correlations are not surprising. The orchid genus *Myrmecophila* with their frequently gorgeous flowers provides exemplary examples in this regard. I strongly suspect that if orchidophiles learnt more about the ecology and nutrition needs of ant-orchids, they would have far greater success cultivating them. See flower images here: Myrmecophila grandiflora

All species of *Myrmecophila* have hollow pseudobulbs with small entrances near their base that enable ants to use them as nests. Ant colonies fill older pseudobulbs with plant nutritious detritus from which home plants glean their nutrient fertilisers as it decomposes. Yes, it has long been known that some plants have learnt to manipulate ants in order to be fed, if only indirectly. (Rico-Gray et al., 1989) Of note is that *Myrmecophila* like *Grammatophyllum* prefer hot and particularly sunny positions.

Ant-house species are a subset of myrmecophytes that actually provide ants with ready-made homes. Indeed, inside some tuberous epiphytes there are gallery-tunnel systems comparable to what ants would build underground but these myrmecodomatia (little ant homes) are provided entirely by the plant (See Fig. 9, see also Section). Many plant species provide them but we are here concerned only with those that live primarily on trees.

Now we take another slight diversion, primarily to show an ability that is unlikely to be found in ant-house epiphytes, consequently providing insights into the unique aspects of ant-epiphyte physiologies. Rainwater, as it percolates downward through canopy soils, absorbs soluble substances to become the leachates that provide important nourishment for many epiphytes. Velamen radicum is the thick, often silvery-white epidermal covering seen on the

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roots of many epiphytic orchid and aroid species. I will now quote some revealing snippets from a study by Zotz & Winkler (2013.) "*We tested the notion originally put forward by Went in 1940 that the velamen allows plants to capture and immobilize the first solutions arriving in a rainfall, which are the most heavily charged with nutrients. In a series of experiments, we examined whether all necessary functional characteristics are given for this scenario to be realistic under ecological conditions. First, we show that the velamen of a large number of orchid species takes up solutions within seconds, while evaporation from the velamen takes several hours*." "*Thus, our results lend strong support to Went's hypothesis: (that) the velamen fulfils an important function in nutrient uptake in the epiphytic habitat*." A pronounced ability to utilise leachates may be found in a few somewhat myrmecophytic orchids but is probably lacking in most other myrmecophytes especially ant-house forms.

Fig. 7 & 8 - The habitats of true ant-house species can overlap with humus impounders. Here some tuberous *Myrmecodia* species are perched on a tree trunk enclosed by an Oak-leafed Fern *Drynaria quercifolia*. // Ant-house plants such as this very rare *Squamellaria thekii* often perch in the most improbable places. Des Voeux Peak, Taveuni Island, north east Fijian Islands.

I am not aware of studies that look specifically at the uptake abilities of any ant-house species root systems but they are probably not particularly efficient in this regard. Yet, the tuber surfaces of those ant-house species accordingly equipped are probably quite efficient imbibers of leachates.

We have already seen hints that the ability of some epiphytic plants to manipulate ants can permit them to expand beyond the benign environments of canopied forests. It is among such species we find some truly bizarre and fascinating plants.

Fig. 9 – A dissected windfall *Myrmecodia sp.* showing smooth walled chambers where ants rear their young and 'warted' chambers where they deposit colony debris. Cape York Peninsula, North Queensland, Australia.

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Part two, Fijian Species.

The Republic of Fiji is a tropical Melanesian country in the South Pacific Ocean east of North Queensland, Australia. It is an archipelago comprising more than 332 islands and 500 plus islet/atolls and innumerable coral reefs that historically has made navigating its waters extremely hazardous. Yet these marine features now make Fiji a very popular tourist destination especially for scuba divers.

The latitudes of these widespread islands cover an area approaching 16 degrees south to 20 degrees south. To the west, Cairns in tropical North Queensland, Australia is fractionally under 17° S, while Townsville sits at about 19.25° S. A little north of Townsville marks the southern boundary for *Myrmecodia beccarii* that is Australia's southern most myrmeco-epiphyte species. See Fiji map here: Fiji map

Fig. 10 & 11 - Rainforest on the wet side of Taveuni Island near Tavora Falls, Bouma National Park, Fiji. // *Asplenium australasicum* (Bird's Nest Fern or Crow's Nest Fern) is an epiphytic humus impounding fern species. These particular plants were photographed from the coastal walkway near Lavena Village on Taveuni Island's wet side.

Viti Levu and **Vanua Levu** are the only two big islands, Viti Levu in the southwest has both international airports (Nadi & Nausori), so it is the international gateway while Vanua Levu in the northeast is serviced by domestic flights and ferries. These large islands sustain 87% of a population of a little over 850,000. Both are very mountainous and rugged, so most inhabitants live on lowlands nearer the coasts where principal roads are more likely to be sealed. Inland, especially in the high mountains, roads become ever more challenging and a robust 4WD vehicle is essential.

Fig. 12 & 13 - *Squamellaria major*, tuber detail. // Two specimens of *Squamellaria major*. Both pictures were taken on the Des Voeux Peak track, Taveuni Island, Fiji.

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Taveuni is an island of some importance to students of epiphytic myrmecophytes. Being only 10.5 k wide and 42 k long it is much smaller than the big two but it still ranks as the third largest island in the archipelago. It is dotted with about 150 volcanic cones including Uluigalau, Fiji's second highest peak at 1241 m. (4072 ft.)

Des Voeux Peak the next highest on Taveuni reaches 1195 m (3921 ft.) and is of particular interest because at its top stand a number of television and mobile phone towers. Consequently, a very rough 4WD track, an extension of unsealed Tavuki Rd, was built to permit rare vehicle access into the high rainforest.

Fig. 14 & 15 - Des Voeux Peak track, Taveuni Island, Fiji. // Highland terrain up on the central plateau. Viti Levu, Fiji.

Like many of the Fijian islands including very tiny ones, Taveuni receives many tourists from all over the world attracted primarily by its world-class reefs and marine life. Yet it is of special interest to biologists because being mongoose free it is still home to the Fiji banded iguana *Brachylophus fasciatus.* Two other closely related species, the crested iguana *B. vitiensis* are now restricted to Yadua Taba, Monuriki and Macuata Islands, while *B. bulabula* occurs on Ovalau, Gau, Kadavu and Viti Levu Islands: Fijian iguanas. In recent years, the American Green Iguana, *Iguana iguana* has become established on Taveuni and some smaller islands. It is believed to have been illegally introduced by yacht-persons who brought them from South America.

Fig. 16 & 17 - *Squamellaria imberbis* sits typically high in the canopy, hence challenging to photograph. Des Voeux Peak track, Taveuni Island, Fiji. // *Squamellaria major*, at the same location.

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Fiji is also home to two endemic amphibians, the Fiji Ground Frog *Platymantis vitiana* that should not be confused with the Fijian tree frog *Platymantis vitiensis.* This latter frog has been frequently associated with the water-impounding epiphytic asteliad *Collospermum montanum* a detail of interest to New Zealanders because we have native *C. hastatum* and an introduced Australian Tree frog *Litoria ewingi.* There are also nine reptiles in the Fijian islands. Fiji is a yachter's paradise outside of the high-summer cyclone season. American iguanas in Qamea

On larger islands especially, these endemic animal species have been either endangered or eliminated by carnivorous mongooses foolishly introduced from India. On Viti Levu from the highest ridges to the well-populated lowlands, I frequently saw the Small Indian Mongoose *Herpestes auropunctatus* a diurnal species, racing across the road ahead. A thriving population of the larger but probably nocturnal species, the Indian Brown Mongoose *Herpestes fuscus,* was found on Viti Levu in 2009. It is probably a zoo escape. See also: Biologic Invasions

However, a subject far more pertinent to these notes is that Taveuni Island is home to all three species of *Squamellaria.* These truly bizarre plants occur nowhere else in the world except for lone *S. imberbis* that also grows on Vanua Levu Island but that is only 6.5 k away across the Somosomo Strait.

Having photographed it, I can confirm that Taveuni is home to *Hydnophytum wilkinsonii* another tuberous ant-house species also found on Viti Levu, Vanua Levu and a few of the small high islands.

Other plants of interest are one the world's largest ferns in terms of frond size if not total height. Giant or King ferns are members of the taxonomically unresolved *Angiopteris evecta* complex of taxa. There was a magnificent specimen with fronds high above my head growing just before the unbridged river crossing to the second Tavora Waterfall in Bouma National Park.

Fig. 18 - *Grammatophyllum elegans* and its root mass growing on a Coconut tree at Pacific Harbour, Viti Levu Island, Fiji.

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Fiji's national flower is the Tagimaucia *Medinilla waterhousei* a liana with attractive white and crimson flowers found up near Taveuni's crater lake and no where else in the world.

An airport for small planes sits at the island's northern tip and a sealed coastal road serves the various resorts and major settlements, but roads on the island's wet side are unsealed and those into the hills become challenging especially when it is wet.

I first explored the wetter side of Taveuni, which being exposed to the southeast trade winds can receive up to 12 m of rain annually. Nevertheless, I found little of myrmecophyte interest except for a few ***Grammatophyllum elegans*** orchids growing in typically weather exposed lowland positions but even these were most common on the far drier north side of the island, which is protected by the long central mountain ridge from prevailing winds. The orchids in this genus probably have most of their symbiotic relationships with opportunistic ant species but although not seen in Fiji, they do frequently grow close to ant-house species such as *Dischidia* or *Myrmecodia*, hence profiting from their neighbour's mutualistic (equally beneficial) ant relationships.

Squamellaria has only three species making it the smallest genus within the sub-tribe Hydnophytinae of the Rubiaceae, a plant family with better-known members such as coffees and gardenias. All genera of the Hydnophytinae possess species with semi-hollow tubers that contain internal tunnel/chamber systems similar to what an ant colony would build underground. Yet these potential ant nests are grown entirely by these plants; probably a co-evolutionary process supported by the fact that all *Squamellaria* species exist only on islands where their mutualist ant species *Philidris nagasau* also lives (Sarnat, 2009).

Squamellaria are considered to be most closely related to the much larger (50+) ant-house genus *Hydnophytum.* See also: Hydnophytum

Fig. 19 & 20 - *Squamellaria imberbis,* Des Voeux Peak track, Taveuni Island, Fiji. This species possesses semi-hollow tubers that contain internal tunnel/chamber systems similar to what an ant colony would build underground. // *Squamellaria imberbis*, leaf detail.

Yet this latter genus has less differentiated differences on the walls of its internal passageways having 'warts' only on some dead end passages. Yet *Squamellaria* have both smooth-walled and densely warted chambers. (Jebb, 1991b) Ants raise their broods in smooth and dry walled chambers but not in warted chambers. Somehow, home plants are able to manipulate their residents to deposit their varied colony wastes in the warted chambers. Warts perform the function of roots albeit internal ones, being able to extract moisture and its dissolved nutrients from decomposing

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ant wastes (Huxley 1978). It follows that *Squamellaria* have more in common with *Myrmecodia* in terms of differentiated tunnel/chamber linings.

Fig. 21 - *Squamellaria imberbis*, tuber detail and few visible resident ants. Des Voeux Peak track, Taveuni Island, Fiji.

Fig. 22 & 23 - *Hydnophytum wilkinsonii* with *Collospermum montanum*, a somewhat unique phytotelm (rainfall impounding) epiphyte, on the opposite side of the supporting tree trunk. Near Monsuva Dam, Central Highlands, Viti Levu Island, Fiji. // *Hydnophytum wilkinsonii*, tuber detail of a particularly hirsute specimen photographed near Monsavu Dam.

I located all three *Squamellaria* species in rainforest along the extremely rough Tavuki road then track that starts near Waiyevo village and climbs right up to Des Voeux Peak. Although a challenging drive, birdwatchers and those wishing for panoramic views hire 4WD vehicles and the few experienced mountain drivers through their resorts. However, I was disappointed, indeed shocked to learn the next day that my driver was paid only one tenth of the

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amount I paid. Therefore, I strongly suggest cutting out intermediaries and dealing directly with my now myrmecophyte experienced guide. His name is Malakai Rado from Lovinovo Village, mobile # 8477088. He was very helpful to my quest and he even has relatives farming near the lower limits of the upland forest that actually have *Squamellaria imberbis* growing on a tree immediately alongside their very modest home. Life for these farmers is incredibly tough.

S. imberbis was by far the most common species seen followed by ***S. major*** but ***S. thekii*** proved to be even rarer; nevertheless, I believe I have photographed one lone specimen. This was not surprising as records indicate only a single collection of *S. thekii,* so it was formally described from very limited material, perhaps why my specimen is not a perfect match to its type description. Not surprisingly, the most common species *S. imberbis* is the one that also occurs on nearby Vanua Levu Island.

Fig. 24 & 25 - *Hydnophytum wilkinsonii* tuber detail, photographed near Monsavu Dam, Central Highlands, Viti Levu Island, Fiji. Note the strapping root system. // *Hydnophytum wilkinsonii* leaf detail.

Hydnophytum wilkinsonii is another Fijian endemic that I first photographed among the *Squamellaria* on Taveuni but I was not aware of this until I was able to see my images on the larger screen of my computer after I returned home. All too frequently, myrmecophytes are positioned high in trees making photography and especially close study rather challenging. Most *Hydnophytums* were photographed on the following island where *Philidris nagasau* does not exist.

Viti Levu Island. On my first day, I explored the Nausori Highlands above Nadi but even at high altitudes, there were few epiphytes in this dry region and I found nothing of interest. The following day my focus was the higher mountains up near Monsavu Dam (pronounced and often spelt Monasavu) Therefore, my Toyota Hilux and I headed inland after leaving the sealed northern King's Highway about 3.5 km beyond Tavua Township.

The sugarcane farms on the dusty plains were quickly passed and soon I was climbing a very winding and steep gravel road up an escarpment with many switchbacks but it was not too challenging for the vehicle I was driving. Yet not an ant-plant to be seen!

I passed through Nadarivatu Village at 900 m, which was the Government Station in Colonial times and is now a local administration centre. Here it can be cooler than the lowlands, not that I noticed much difference in the heat of the day. Yet it is one of the few places in Fiji where heating fires are sometimes needed at night.

Although there were many large undulations in this very rugged terrain, I gradually gained more altitude and epiphytes were becoming more common in these moister heights. Nevertheless, it was not until I eventually reached higher ridges nearer the island's centre that I spotted my very first *Hydnophytum* but it was high in a tree

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and too far way to see clearly**.** However, when one is found, others usually appear nearby and that proved to be the case. I took many photos; indeed some 400 on this expedition but some are more of a tourist interest.

I expected to find only *H. wilkinsonii* at these altitudes but a later study of enlarged images showed that my very first sighting was very probably a specimen of *H. longiflorum,* a species that can even occur behind mangroves thus at sea level. *H. wilkinsonii* has very hairy tubers while *H. longiflorum* has smooth tubers. However, it is very probable that older plants of *H. wilkinsonii* can lose their hairs. so it is not a perfect diagnostic for some specimens. Another difference is that the leaves of *H. wilkinsonii* tend to be more oval than the linear leaves of *H. longiflorum* but there is some overlap. A dissection of flowers can provide a better diagnostic but that is not very helpful when plants are high in trees and flowers are sparse. However, most plants photographed in the highlands proved to be *H. wilkinsonii.*

I finally got to a position on the plateau in north central Viti Levu where I could actually see the lake behind Monsavu Dam in a valley below but here the road became so badly formed, I decided that proceeding further was silly, so I turned back toward civilisation.

Mitchell (1986) in his fascinating book about the early days of canopy research mentions Fijian hydnophytums. I quote. "*Centipedes and spiders lodge there, their prey adding to the carcasses*" "*flatworms and sand hoppers live in the moist interior, along with the occasional primitive peripatus; worms and nematodes can often be found slithering through the ant compost*." He also writes about a beautiful and hitherto unknown yellow gecko that was discovered inside a Fijian ant-house plant growing on a partly swamped tree behind Monsavu Dam.

Fig. 26 - *Hydnophytum longiflorum,* Colo i Suva Forest Park, Suva, Viti Levu, Fiji.

It was on a high ridge in this general area that I first heard what I thought was a vehicle intrusion alarm sounding loudly from a valley below. A little later, another alarm sounded from a very different direction. This was most unusual in such a remote wilderness; I eventually decided I must have been hearing a bird; yet surely one of the most unusual bird sounds in the world. It was the aptly named Ambulance Bird, otherwise known as the Giant Forest

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Honeyeater or Yodelling Honeyeater *Gymnomyza viridis;* a species endemic to Fiji in lowland or montane forest habitats where it is threatened by habitat loss.

Hydnophytum longiflorum is more of a lowland species even occurring if only rarely at the rear of mangrove forests. It is supposedly very common in the wetter southeast of Viti Levu, which is unusual for myrmecophytes, which often prefer somewhat drier but not overly dry habitats. Yet like many other hydnophytums and other myrmecophytes, they tend to grow in medium to high positions on tree trunks or larger branches with zero canopy soils, so they are exposed to regularly dry interludes. Unfortunately, in the southeast of Viti Levu sprawls unruly Suva City surrounded by Fiji's most populated regions; therefore, the land has been drastically modified by homes, agriculture and other nature-destructive human influences. Some early herbarium specimens were collected from what are now Suva's most populated suburbs.

Consequently, it was not surprising that my first days of exploration failed to find a single hydnophytum. Again, I got near to Monsavu Dam from this opposite direction but once again, the last section of road proved to be horrendous. Trying to drive right across Viti Levu over this inland route, hence over the highest ranges is perhaps not impossible but decidedly difficult because a length of 'road' in the islands middle has not been maintained since the dam was built some decades ago. I therefore decided to try a site very close to Suva.

Colo i Suva Forest Park (pronounced *tholo-ee-soo-va*) is a 2.5 square km reserve that sits above Suva at altitudes between 122-183 m (400-600 ft.) Park headquarters are on the left of Queen's Highway about 11 km along if driving up from central Suva. Travel guides report the possibility of robberies in the park and advise travelling in groups or hiring a local guide or two, Guides are very cheap to hire and they surely need the income because hourly rates are poor. I tended to choose adequate but less expensive accommodations so that I could help more in tips for the workers.

Fig. 27 - The smooth tuber and leaf shape indicate these are probably *Hydnophytum longiflorum*. Nadrau Plateau, Central Highlands, Viti Levu Island, Fiji.

I spent two days in the park carrying expensive photography gear with absolutely no problems. However, I move quietly and if needed I could disappear into the jungle before on comers were aware I was there.

The park was logged some decades past but now lush native rainforest is interspersed with maturing Mahogany trees native to the Americas and planted some decades ago. Some 6.5km of walking trails pass waterfalls, natural swimming pools, varied rainforest vegetation, including orchids and most importantly *H. longiflorum*. Yet these were seen only in a small area of the park at lower altitudes but being such a highly disturbed forest my sightings probably provide little indications of their true preferences in undisturbed forest. Once again strange 'vehicle alarms' rang out from high in the forest canopy but this time accompanied by the flapping of wings.

Taxonomy. In the absence of Dr Matthew Jebb's long delayed revision of *Hydnophytum*, one cannot be very sure of what names the Fijian species may have in the future but he accepts two species and I expect they will be what I am using.

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Part three, New Britain Island.

New Britain Island is the largest island (centre of map) in the Bismarck Archipelago, a territory of the sovereign nation of Papua New Guinea. Although it is far less populated, New Britain Island is about the same size as Taiwan. Papua New Guinea is the large landmass positioned immediately above Australia. Part of Australia's Cape York Peninsula along with its tiny Torres Strait island territory is shown south of the borderline (black lower left.) New Ireland is the long very narrow island to the north east of New Britain which is in the map's centre. The autonomous territory of Bougainville Island (and its much smaller outliers) is the largest island of the Solomon Island Archipelago positioned to the south-east of the Bismarck Archipelago. The other Solomon Islands positioned south of the border (black line middle right) form the sovereign Solomon Islands nation with Honiara on Guadalcanal Island their capital city. Most of these islands including the numerous small islands to the west of New Britain along Papua New Guineas north coast are home to many fascinating myrmecophytes. Lone Manus and the rest of the Admiralty islands to the north also host myrmecophytes.

Fig. 28 – New Britain Island (Map Wikimedia commons. Creative Commons Attribution-Share Alike 3.0 Unported license)

The main towns of New Britain are the twins Rabaul and Kokopo on the Gazelle Peninsula at the island's north eastern end and Kimbe in less developed west New Britain. I found Kokopo Township to be somewhat modern and developed by island standards, especially when compared to Bougainville Island but that island has been severely devastated by civil war. Both Kokopo and Kimbe are served by Air Niugini. Principal roads were sealed but those into the hills and especially the mountains require a robust 4WD.

This mountainous island has several active volcanoes such as Ulawun, the highest in all of Papua New Guinea, as well as Langila, the Garbuna Group, the Sulu Range, and Tavurvur and Vulcan. These latter two are positioned alongside the enormous Rabaul caldera at the tip of the Gazelle Peninsula. Many persons living nearest to the Rabaul volcanoes were evacuated because of eruptions in 1994 and the devastation is still very apparent. As a result nearby

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Kokopo has become a more popular place to live even though it does not have the shipping access provided by the caldera's enormous harbour.

Volcanoes tend to produce very fertile soils and these along with excellent rainfall, and a location very close to the equator has clothed the island in lush tropical rainforests. However, much of the lowlands have been converted to enormous plantations of balsa, cocoa, or coconut, but fortunately at least some of the islands myrmecophytes have adapted rapidly to life in such disturbed surroundings. Indeed, as I left my hotel to start myrmecophyte hunting there was an ant-house *Dischidia* on a tree near the hotel's entrance.

Fig. 29 & 30 – Turvurvur Volcano, Rabaul, East New Britain Island, Papua New Guinea, erupting on the 5th of August 2011. // Rabaul. This was once a golf course, now the lawn is underneath the volcanic ash.

Fig. 31 & 32 – The low-lying Rabaul Caldera, on the tip of the Gazelle Peninsula, forms a broad sheltered harbour. // This tree in the grownds of my hotel also supported a *Didischia* species, possibly *D. imbricata.*

Dischidia like many myrmecophyte taxa from remote locations requires a modern revision; therefore, providing accurate names is currently rather challenging. Most species are myrmecophytic to some degree and those that do not directly provide homes to ants often still need these industrial insects nearby to further their own unique survival strategies. (e.g. Weir & Kiew, 1985) In addition, there are numbers of species that grow out of arboreal ant-carton nests, creating what are known as ant-gardens. Ant gardens are considered to be among the most complicated

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animal plant relationships in our world; hence they are scientifically important study subjects. See also: Myrmecological News

Fig. 33 & 34 – *Dischidia imbricata* on a plantation Coconut tree on the Rabaul Kokopo Road, Gazelle Peninsula, East New Britain Island, PNG. // An ant-house *Dischidia imbricata,* in the grounds of my hotel, Kokopo, Gazelle Peninsula.

Fig. 35 & 36 – *Didischia imbricata* – detail of plant with flower peduncle. // *Myrmecodia tuberosa* "dahlii" in dense canopied Cocoa plantation above Kokopo, Gazelle Peninsula.

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Many of the domed leafed species and there seems to be many published names if not currently accepted species, are very similar to each other, so one must be wary of names, especially those used in horticulture. The somewhat domed leaves of many *Dischidia* species closely clasp the bark of trees creating spaces beneath that ants use for rearing future generations. These leaves are often imbricate which means that they may overlap, somewhat in the manner of roof tiles. Adventitious roots from nearby leaf nodes penetrate beneath these domes to access leachates from the decomposition of discarded ant debris and the constant defecations of resident ant colonies. Such epiphytic roots have protection from environmental impacts such as excess sunlight and too rapid dehydration. Furthermore, resident ants will provide some protection from varied plant eaters and even some plant pathogens by keeping surfaces clear of intruding life forms especially fungi.

Later we will explore a few *Dischidia* species that have refined this bullate leaf adaptation to a truly remarkable extent.

Incidentally, asclepiads are no longer placed in the Asclepiadaceae. That family has long been reduced to sub family Asclepioideae, in the Dogbane family Apocynaceae. See also: Angiosperm Phylogeny Group

Myrmecodia like *Squamellaria* are tuberous members of the sub-tribe Hydnophytinae, family Rubiaceae and both genera have internal gallery systems divided between smooth and 'warted' wall examples. Moreover, both genera have evolved to accommodate only ants, whereas *hydnophytums* and other hydnophytinae genera frequently have bigger entrance holes so that they often house larger invertebrates or even vertebrates such as frogs or lizards. (Tyler, 1976; Huxley, 1978; Mitchell, 1986) Yes, the popular name 'ant-plants' is not totally accurate because nature often finds very new directions for its evolutions.

Fig. 37 - *Myrmecodia tuberosa* "dahlii" in plantation forest above Kokopo, Gazelle Peninsula.

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A few usually mundane forms of ***Myrmecodia tuberosa*** are among the small number of hydnophyte ant-plants in cultivation. Yet in nature it is an extremely widespread species with many quite distinct regional forms, yet very few are in cultivation at least in the 'western' world.

In an effort to document this variation Huxley & Jebb (1993) have assigned taxonomically unofficial trinomial names to this species; however, where they use single quotation marks, I prefer to use double quotation marks as in the following example.

Myrmecodia tuberosa **"dahlii"** is the form found on New Britain and New Ireland; however, towards the southern end of the latter island it gradually morphs into the "salomonensis" form. One we will see in a later Solomon Island chapter. It proved to be a very common species, sometimes growing very high in mature trees, yet often near head height under the dense canopies of low growing plantation forests. Here shade and broken light makes photography a little more challenging but I carry a powerful flashgun for such eventualities.

Hydnophytum and ***Lecanopteris*** species have been recorded on New Britain Island but I failed to find any.

Fig. 38, 39 & 40 – A row of tiny *Myrmecodia tuberosa* "dahlii" babies growing on an ant carton tunnel in planation forest, Kokopo, Gazelle Peninsula, East New Britain Island, PNG. (above) // This plant is probably a small form of the very widespread *Dischidia nummularia*, a frequent hemiparasite of myrmecophyte symbioses. Bita Paka War Cemetery, Rabaul, East New Britain Island, PNG. // *Dischidia* species with quite succulent leaves above Kokopo, East New Britain Island, PNG.

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Part four, Australian Myrmecophytes.

Myrmecodia beccarii is an Australian endemic hydnophyte that occurs in the Wet Tropics of tropical North Queensland from a little north of Townsville to a little north of Cooktown. This relatively narrow region east of the escarpments of the Great Dividing Range has heavy summer rainfall with lesser precipitation during 'winter' months but without the distinct dry season of the Monsoon Tropics north of Cooktown. West of the escarpments is predominantly the dry to very arid Australian Outback. See also: Wet Tropics of Queensland, Maps, and National Landscapes - Wet Tropics

There are two distinct forms of *M. beccarii* (See Fig. 41). One occurs in the far south of the species large latitudinal range. This form has a smooth epidermis with few to zero spines, thus its tubers somewhat resemble those of most *Hydnophytum* species, except that they are particularly rotund ones. I use the cautious word *most* because a few hydnophytums are spiny. The far more latitudinally widespread northern form is as typically spiny as its other congeners, except that old plants often lose their spines (See Fig. 42).

Fig. 41 & 42 – *Myrmecodia beccarii* "northern form" note the spines. Near Saltwater Lake, Cairns Botanical Gardens, North Queensland, Australia. // *Myrmecodia beccarii* (the southern spineless form), here with its frequent companion the hemiparasitic so-called button orchid *Dischidia nummularia*. Photographed in Hinchinbrook Channel Swamps, North Queensland, Australia.

Some *M. beccarii* habitats such as the large mangrove forests and Tea tree *Melaleuca viridiflora* swamp forests along the Hinchinbrook Channel south of Cardwell, have a few dangers if only for the unwary, such as several of our world's most venomous snakes and very sneaky Saltwater Crocodiles *Crocodylus porosus*. Yet much more

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unpleasant can be horrendous swarms of mosquitoes and sandflies. Certainly, this latitudinally smaller area, home to the (mostly) spineless *M. beccarii* "southern form" is one of the places where photographers need to be cautious and to carry lots of insect repellent. See also: 10 Most Dangerous Snakes in Australia and Saltwater Crocodile.

Cairns and nearby

Fortunately, there are many places where *M. beccarii* and its companion plants may be observed very easily and very safely. Most of the Cairns suburbs that have retained beachside parks, reserves and walkways, especially near mangroves often have specimens.

The Jack Barnes Bicentennial Mangrove Boardwalks

Most tourists and there are many, fly into Cairns International Airport, which is only a few kilometres from the centre of this upmarket and vibrant little city. On the left as one drives down Airport Avenue toward the left hand turn south into the city, there is a small car park beside a large expanse of mangrove forest. From here, two raised boardwalks give very safe and very easy tourist access out onto the mudflats where one may see mudskippers, hermit crabs and other small marine animals.

Fig. 43 - The orchid *Dendrobium discolor* on a deciduous mangrove *Xylocarpus moluccensis* with *Myrmecodia beccarii* "northern form" on the right , Cairns Mangrove Board walk, North Queensland, Australia.

Of a more pertinent interest there, perched on the mangroves on either side of the walkways, is a selection of xerophytic orchid species and numbers of very high quality ***Myrmecodia beccarii*** "northern form" specimens (See Fig. 43). Sometimes these are just inches away and they are often intimately accompanied by their hemiparasite, the succulent-leafed epiphyte ***Dischidia nummularia*** (See Fig. 44).

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Fig. 44 & 45 - *Myrmecodia beccarii* "northern form" juveniles with *Dischidia nummularia*, Cairns Botanical Gardens, North Queensland, Australia. // *Myrmecodia* beccarii on a narrow band of stilted mangroves on the south coast of Trinity Inlet, Cairns. This would seem to be a very harsh habitat for epiphytes, yet as one can see, these plants are in excellent condition. Their resident ants must be feeding them well and these examples provide evidence that these plants are more than merely xerophytic, they are succulent.

It is notable that one of the most popular host trees of *M. beccarii* in these mangroves is the dry-season deciduous species *Xylocarpus moluccensis* (See Fig. 45).

The boardwalk at the northern (airport) end of the car park has the most ant-plants and orchids, especially when one nears the more open habitat near Middle Creek, where if one approaches very quietly, there may even be a small crocodile lurking. Mangrove Boardwalk

The Flecker Botanical Gardens, Cairns

See also: Flecker Garden and Saltwater Lake

These interesting tropical gardens have numbers of easily photographed *M. beccarii* (See Fig. 44) and masses of heavily shaded, hence unusually lax *D. nummularia* festoon some of the larger trees. The mangroves around Saltwater Lake have some excellent and much photographed specimens some below head height. CCTV cameras wisely protect the more vulnerable plants.

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As one would expect for a park situated in the Wet Tropic's, it has much more to offer in terms of tropical plants including a very nice restaurant in most pleasant surroundings.

Cairn's Region Beachside Suburbs

Numbers of the beach communities in the Cairns region have retained enormous Paperbark *Melaleuca* trees sometimes interspersed with very upmarket buildings such as at Port Douglas. A row of huge trees at popular Palm Cove beach also houses *M. beccarii,* at very safe heights from humans (See Fig. 46).

Even the Palm Cove caravan park has numbers in their Paperbark trees; some of which are particularly magnificent.

Fig. 46 & 47 - Giant Paperbark Trees (*Melaleuca* sp.) along the sea front at popular Palm Cove, North Queensland, Australia. There were *Myrmecodia beccarii* "northern form" high in these trees. // *Myrmecodia* beccarii "northern form" slightly damaged, hence showing hints of its internal gallery systems. Cairns Botanical Gardens, North Queensland, Australia.

Trinity Inlet

On the south coast of Trinity Inlet, part of which is the Port of Cairns, I found a colony of *M. beccarii* occupying a very narrow band of Stilted Mangrove *Rhizophora stylosa* on a silica sand beach. It would seem an extremely difficult site for any epiphytes, yet the colony appeared to be exceptionally healthy (See Fig. 45). Resident ants were obviously bringing in plenty of nourishment for themselves and indirectly for their host plants.

Fig. 48 & 49 - *Myrmecodia beccarii* "northern form" near Cooktown Botanical Gardens, North Queensland, Australia. // A magnificent mature specimen of *Myrmecodia beccarii* "northern form" in a Paperbark swamp near Cooktown.

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Fig. 50 - *Myrmecodia beccarii* "northern form" in a Paperbark swamp near Cooktown, North Queensland, Australia. As usually it is accompanied by the parasite of its mutualistic relations, the scandent (climbing) vine *Dischidia nummularia.*

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Cooktown

This is a small frontier town and one of the Gateways to Cape York Peninsula, the other being through Mareeba up on the tablelands. A little north of Cooktown marks the northern boundary of *M. beccari*i habitats.

Cooktown has an interesting Botanical Garden where one may see *M. beccarii* and *Dischidia major* (see later) along with many other tropical wonders both plant and animal.

There are some magnificent mature *Myrmecodia beccarii* in this region but be observant in the bush, arboreal wasp nests are common here in the tropics but fortunately their stings do not hurt for long. With the region's many snakes, it can be a very different matter and the many salties (a colloquial name for Saltwater Crocodiles) are very unforgiving of the foolish but make sure you visit the famous Crocodile shop.

There is now an excellent sealed highway from Cairns. See also: Cooktown, Queensland and Botanic Gardens.

Myrmecodia platytyrea* subsp *antoinii has a range that overlaps the northern part of *Myrmecodia beccarii* habitats but it is not littoral in its choices.

Mossman Gorge

This southern section of the world heritage listed rainforests of Daintree National Park is an exceptionally popular tourist venue only about 80 km (50 miles) north of Cairns. On my last visit (my third), I had to park a couple of kilometres away where a bus continually took tourists to and from the Gorge entrance, obviously to eliminate the vehicle congestion that had become so bad in the past.

Fig. 51 - *Myrmecodia platytyrea* subsp. *antoinii* in rainforest Mossman Gorge, Daintree National Park, North Queensland, Australia. Anomalous specimens in an improbable habitat.

A location in dense rainforest is an unusual setting for this species, indeed for many myrmecophytes and these specimens do not resemble the form seen much further north in the Monsoon Tropics that endure very distinct six to seven month dry seasons. They certainly are uncharacteristic rather ugly plants and difficult to find being high in a liana and epiphyte-burdened canopy (See Fig. 51).

The first specimens are visible from a concreted pathway near the gorge entrance high in a tall tree to ones left, others can be seen from a bushwalking track up a ridge further along but all are easily missed. Certainly, very few tourists would notice them and far less would be aware of their interesting survival strategies.

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These very weather-beaten and unusually multi-branched plants were photographed in rain; it is after all, a Wet Tropics rainforest.

Other plants of somewhat allied interest are the basket ferns *Drynaria quercifolia,* and *D. rigidula* and some succulent to semi succulent *Hoya australis* subsp. *australis, H. australis* subsp. *tenuipes, H. pottsii* and some orchids.

The reptile Boyd's forest dragon *Hypsilurus boydii* were once common on tree trunks but I failed to see any on my last visit.

Mossman Mangrove Forest

Dischidia major (See Fig. 52). Mossman is the most southerly habitat for this very interesting species in Australia. Here it has an exceptionally coastal habitat growing on mangrove trees or on nearby Paperbark trees. The species extends to the tip of Cape York Peninsula and far beyond but there; its usually lowland habitats are often inland. These southern, greener plants attain much smaller overall sizes that do northern populations but individual domatia leaves are equally as large.

D. major provides an extension to the ant housing adaptations we have seen in domed-leaf *Dischidia* species (section Ascidiophora.) Here domatia leaves are hollow with a tiny entrance hole situated at the petiole (usually lower) end of each leaf. Ant colonies choose to live in these hollow leaves while gradually filling them with plant nutritious debris. When domatia leaves become too full for the ant's requirements, they move to the younger empty ones that home plants are continually growing. These plants also grow 'normal' laminate leaves but if drought threatens these are rapidly lost at an inbuilt petiolar abscission layer; surely indicating which leaf type is most important for survival.

There are only two other *Dischidia* species with hollow leaves and one *Hoya*. *Hoya* is closely related to *Dischidia* so it is not surprising that both have myrmecophytic species.

Fig. 52 & 53 - *Dischidia major* in outer canopy of mangrove tree, south of Mossman, North Queensland, Australia. // Mangrove swamps south of Mossman, Queensland, Australia. Warnings signs as crocodiles frequent the area.

Roots from nearby leaf nodes enter each domatia leaf through the same opening that the ant colonies use. Tests have shown that these roots definitely do glean nutrients from decomposing ant debris. Not only do these plants receive a vital 'food' source but they also absorb concentrated carbon dioxide exhaled by their colonists inside each leaf. This reduces the need to open external stomata thereby reducing transpirational water losses. As a result, these plants are able to survive in habitats far too harsh for almost all other non-myrmecophyte epiphytes. A truly remarkable adaptation. See also Treseder et al. 1995.pdf

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Fig. 54 - Habitat of *Myrmecodia beccarii*, *Dischidia major*, *D. nummularia* and Australia's largest orchid *Dendrobium discolor* in Mangrove swamps south of Mossman, North Queensland, Australia.

Fig. 55 Habitat of *Myrmecodia beccarii* in Paperbark (*Melaleuca viridiflora*) swamp forest, Hinchinbrook Channel, North Queensland, Australia. Photographed from the mangrove edge.

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Fig. 56 - *Myrmecodia beccarii* (southern form) Hinchinbrook Channel swamps, North Queensland, Australia. The ”southern form” is distinguished by the complete lack of spines in most specimens. One butterfly (*Hypochrysops apollo*) also benefits from the ant-plant mutualism; it lays its eggs on the plant, and because they smell like the ant's eggs, the ants carry all the eggs inside the plant, allowing them develop to the butterfly stage.

Fig. 57 – *Myrmecodia beccarii* "southern form", Hinchinbrook Channel swamps, North Queensland, Australia.

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Fig. 58, 59 & 60 – *Myrmecodia beccarii* (southern form) with *Dischidia nummularia*. // *Dischidia nummularia* with very compact growth showing flower detail, Hinchinbrook Channel swamps, North Queensland, Australia. // *Myrmecodia beccarii* "northern form" with mistletoe bird *Dicaeum hirundinaceum*, which eats the plant's sweet fruits and helps to spread its seed.

Cape York Peninsula

Although this immense region's unsealed roads have been improved enormously since my first visit, this is still a frontier land that becomes impassable in the immense downpours of the annual monsoon. Rivers then become treacherous torrents, enormous lowland areas disappear under immense floodwaters. Saltwater crocodiles become ever more widespread and many creatures such as snakes become displaced.

In Australia's north, one must be exceptionally wary near water; it is surprising how small bodies of water can contain huge salties. Only a week or so after Attila Kapitany and I were exploring along the Endeavour River near Cooktown, yet another incautious tourist was taken by a salty.

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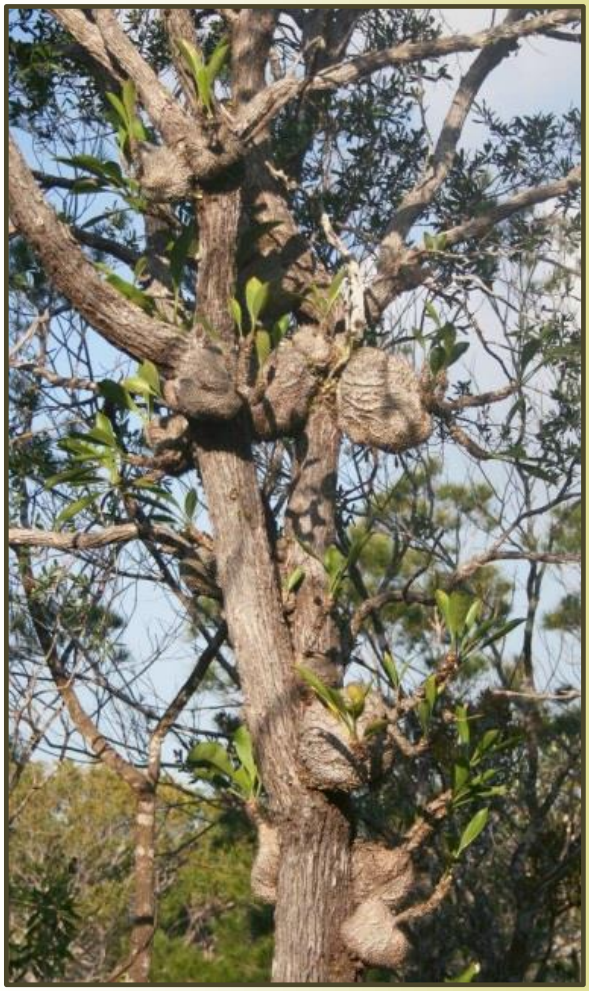

Fig. 61 & 62 - *Myrmecodia platytyrea* subsp. *antoinii*, Iron Range National Park, Cape York Peninsula, North Queensland, Australia. The long line of juvenile plants is typical, indicating ants have probably planted seed in ant carton tunnels. // A large colony of *Myrmecodia platytyrea* subsp. *antoinii* & *Myrmecodia tuberosa* "papuana", Iron Range National Park.

Fig. 63 & 64 - An anomalous population of *Myrmecodia platytyrea* subsp. *antoinii*, near the Portland Roads highway, Iron Range National Park, Cape York Peninsula, North Queensland, Australia.// *Myrmecodia platytyrea* subsp. *antoinii*, Iron Range National Park, Cape York Peninsula, North Queensland, Australia.

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Fig. 65 & 66 - *Myrmecodia platytyrea* subsp. *antoinii* & *Hydnophytum moseleyanum* with orchids. Jardine River catchments, Cape York Peninsula. // *Hydnophytum moseleyanum* (note 'spines') & a succulent orchid *Dockrillia rigida*. Same location.

Giant pythons, highly venomous snakes, enormous bird eating spiders, immense wildernesses, bull dust patches and the frequent terrible corrugations of outback roads make it a region only for the adequately prepared. Yet to nature lovers it is a most fascinating place with enormous interests that is becoming ever more popular. See also: Cape York Tourism, Trek Notes - Cape York and Cape York Itinerary.

Fig. 67 - *Dischidia major* with the hemiparasite *Dischidia nummularia* (upper right, button leaves). Iron Range National Park, Cape York Peninsula, North Queensland, Australia.

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Kutini-Payamu, formerly Iron Range National Park

This particularly fascinating area deep in the wilds of Cape York Peninsula has many magnificent specimens of easily photographed *Myrmecodia platytyrea* subsp *antoinii* as well as *Hydnophytum moseleyanum, Myrmecodia tuberosa* "papuana" (See Fig. 68), and *Dischidia major* (See Figs. 70, 75 & 76). *Hydnophytum ferrugineum* is also reported here but I have yet to photograph it.

Dischidia ovata although not myrmecophytic is an attractive semi succulent vine that sometimes occurs close to *D. major* and *D. nummularia* but it prefers far more benign forest habitats where it hangs in long streamers (See image). It is rarely found in very sunny sites when it then becomes very red with vivid white lines. Certainly, an extremely attractive 'form' but it is a borderline survival condition probably far too dangerous for plant survival to emulate in cultivation.

Fig. 68 - *Myrmecodia tuberosa* "papuana" the opaque red fruits are diagnostic for Australian taxa. Iron Range National Park, Cape York Peninsula, North Queensland, Australia.

It will be a while before the new Aboriginal name for this park (Kutini-Payamu) becomes as well known as Iron Range. Kutini-Payamu

Hydnophytum moseleyanum was quite common in the Iron Range region although usually high in the canopy. Further north, they grew much lower especially in riverine scrubs along creeks flowing into the Jardine River. Here there were hints of the myrmeco-epiphyte guilds common in places such as New Guinea or at Bako in Sarawak,

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Borneo Island. The guilds included *Myrmecodia platytyrea* subsp *antoinii, Dischidia major* and the ant-house fern *Lecanopteris sinuosa* a species common overseas but much rarer in Australia.

Fig. 69 & 70 - *Dischidia ovata* with butterfly, Iron Range National Park, Cape York Peninsula, North Queensland, Australia. // *Dischidia major*, Jardine River catchments, Cape York Peninsula, North Queensland.

Fig. 71 & 72 - Lowland monsoon rainforest, myrmecophytes were rarer under heavy canopies, Iron Range National Park, Cape York Peninsula, North Queensland, Australia.// Riverine forest, home to a myrmeco-epiphyte guild of *Dischidia major*, *Hydnophytum moseleyanum*, *Lecanopteris sinuosa*, and *Myrmecodia tuberosa* "papuana". Jardine River catchments, Cape York Peninsula, North Queensland, Australia.

Carnivorous *Nepenthes mirabilis* sometimes climbed into the host trees of these ant-plant guilds and nearby swamps supported colonies of varied carnivorous plants.

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Lecanopteris sinuosa is the only member of this unusual ant-fern genus that occurs in Australia. It was found near the tip of Cape York Peninsula in headwater creeks of the Jardine River basin (See Figs. 73 & 74).

Fig. 73 & 74 - *Lecanopteris sinuosa* - the only member of this unusual ant-fern genus that occurs in Australia , Jardine River drainage basin, Cape York Peninsula, North Queensland, Australia. // *Lecanopteris sinuosa* - a species common overseas (it has a big distribution range covering most of South-East Asia) but much rarer in Australia. The slender and almost unbranched rhizomes are densly covered by scales. Jardine River catchments, Cape York Peninsula, North Queensland, Australia.

Fig. 75 & 76 - *Dischidia major* with fruits and ant carton. Jardine River catchments, Cape York Peninsula, North Queensland, Australia. The fruit of consists of the usual horn-shaped pair of follicles while the seed has a tuft of silky hairs at one end and includes an edible portion or elaiosome as incentive for ants to move the seed (*myrmecochory*) into their nests, thus providing improved chances of germination and growth.// *Dischidia major* with seeds germinating while still on their mother. Jardine River catchments, North Queensland, Australia.

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Fig. 77 - *Dischidia nummularia* with very compact growth, Hinchinbrook Channel swamps, North Queensland, Australia.

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Part five, Bougainville Island.

Bougainville Island is the largest island in the Solomon Island Archipelago, a long, narrow island chain in the southwest Pacific Ocean northeast of Australia and east of New Guinea mainland. Currently Bougainville is a semi-autonomous territory of the nation of Papua New Guinea, a legacy of its colonial past but it is to have a referendum about possible independence sometime between 2015 and 2020. Like the rest of its archipelago, this island has a predominantly Melanesian population while the peoples of New Guinea are mostly Austronesian.

Both Bougainville and other Solomon Islands have experienced civil war in the very recent past and tensions still exist. The Pacific theatre of the Second World War also left many war relics including unexploded munitions on many western Pacific Islands. See also: History of Bougainville and Solomon Islands.

Fig. 78 & 79 - Panguna Mine & Village ruins, Bougainville Island.// Panguna Mine ruins. Everywhere there were ruins!

My plan was to visit the highlands near the closed Panguna Copper mine on the Crown Prince Range above Arawa Township on the islands central east coast. Here I hoped to find *Hydnophytum kajewskii* and other myrmecophytes (See Figs. 82 to 86). See also Hydnophytum.

Discontent over Panguna Mine became the initial focal point of a civil war that killed some 20,000 Bougainvilleans and devastated much of the island's then modern infrastructure that had been financed by what was the world's largest copper mine. Also because of the civil war, the only operating airfield left in Bougainville Province was on tiny Buka Island off the far north tip of the main island but fortunately only a short water-taxi ride across a very narrow strait. Incidentally, there are plans to reopen nearby Torokina airfield as Arawa slowly but surely stabilises and rebuilds.

Fig. 80 - Abandoned Ore Carriers, Panguna Copper Mine, Bougainville Island, northern Solomon Islands Archipelago.

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The war had also seen the destruction of the bridges across the 15 or so rivers one must cross to get down the coast road from Buka to Arawa, so it was an interesting journey in 2011. These rivers all flow out of high mountains hence they can flood dangerously after tropical rains. Indeed, it had rained heavily the day prior to my journey back up the island to catch a flight to New Britain Island, so I was concerned that I might be delayed. At one crossing, a large semi-trailer was stuck, bonnet underwater, while at another, a tractor had to tow a large 4WD out of the storm flow before we could attempt the crossing. Nevertheless, not to worry, I made my flight and that afternoon although extremely tired; I was photographing myrmecophytes on New Britain Island in the Bismarck Archipelago to the north. However, some of the contents of my backpack were wet.

Fortunately, due to Japanese financial aid, all are now bridged, making the journey so much faster and more reliable.

Arawa is only 6° 13' south of the equator, so it is very hot and very humid; however, above 1000 m. (3281 ft.) near Panguna Mine, it was cooler at least overnight.

Fig. 81 & 82 - Habitat of an enormous atypical *Hydnophytum kajewskii*, Panguna, Bougainville Island. // *Hydnophytum kajewskii*, Panguna, Bougainville Island. Not all specimens had a boat shaped tuber, especially this venerable specimen growing in the very exposed site left.

Hydnophytum kajewskii Merrill & L. M. Perry was published in the *Journal of the Arnold Arboretum* 25(1), pp25-26, 1945. See also: Hydnophytum. Most hydnophytums are largely unknown outside of a miniscule section of academia; however, this one is a little better known due to taxonomist Dr Matthew Jebb's Internet posting above. It certainly is a most remarkable species but although possession of a boat-shaped tuber is a common occurrence, some plants have far more rotund examples, especially so in large venerable specimens. (See Fig. 82)

I found *H. kajewskii* high in the canopy of mangrove/littoral strand forests accompanied by two other almost equally unusual *Hydnophytum* taxa (see next) and many examples of *Myrmecodia tuberosa* "salomonensis" (See Figs. 95, 96, 101 & 102). I photographed more specimens of *H. kajewskii* at elevations around 1000 m (3281 ft.) on the Crown

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Prince Range overlooking Arawa. These were mostly perched under a much lower rainforest canopy; therefore, they were sometimes within arm's reach and there was even a windfall specimen that provided excellent photographic opportunities (See Fig. 84). One particularly large and presumably ancient plant grew on a small tree on a steep mountainside extremely exposed to the elements (See Fig. 82).

Fig. 83 & 84 - *Hydnophytum kajewskii*, Panguna, Crown Prince Range. Bougainville Island. // Derrick Rowe holding a windfall *Hydnophytum kajewskii*, near Panguna Mine, above Arawa, Bougainville Island.

Fig. 85 & 86 - *Hydnophytum kajewskii*, Panguna, Bougainville Island.

The tubers of this species often contain rainwater and cockroaches but ants were rarer (Guppy, 1887). Although Dr. Guppy used the name *H. guppyanum* in his book, he describes them as having a scaphoid (boat) shape, so he is referring to what is now accepted as *H. kajewskii.* Herbarium materials of both *H. kajewskii* and *H. guppyanum* were mixed together on a single herbarium sheet thereby creating early taxonomic confusions.

Hydnophytum guppyanum Odoardo Beccari was published in *Malesia Raccolta* 2, 129, 1885.

Synonyms ***H. hahlii*** Karl Rechinger, published in *Repertorium Specierum Novarum Regni Vegetabilis* 11, 186, 1912, and ***H. longipes*** Merrill & L. M. Perry, published in *Journal of the Arnold Arboretum* 25(1), 23-24, 1945.

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This is another most unusual member of its genus with a large tuber that reminds one of *Squamellaria major* from little Taveuni Island, Fiji.

Fig. 87 - *Hydnophytum guppyanum*, Tunurua mangrove swamp, Bougainville Island.

In the absence of a modern revision of hydnophytums, it has been challenging to apply names to Bougainvillean or indeed most species but there are enough clues in the literature and in on-line herbarium records to be very confident of the accuracy of these first two species.

Fig. 88 & 89 - *Hydnophytum guppyanum*, Tunurua mangrove swamp, Bougainville Island, Northern Solomon Islands Archipelago. // The shape of the large tuber reminds one of *Squamellaria major* from little Taveuni Island, Fiji.

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Hydnophytum longistylum Odoardo Beccari published in *Malesia Raccolta* 2, 152, 1885. This is the name that I prefer to use for my Bougainville sp1. Although the leaves and stems of these plants do resemble those of *H. moseleyanum.* I find their tuber surfaces to be much more muricate (roughened with sharp hard points) and with many more lipped entrances than the *H. moseleyanum* I am familiar with in Australia and New Guinea which have red fruits and a very smooth epidermis.

Fig. 90 & 91 - Highland habitat of *Myrmecodia tuberosa* "salomonensis & *Hydnophytum kajewskii*, Bougainville Island. // *Hydnophytum longistylum.* Tunurua mangrove swamp, Bougainville Island. Note the unusual galled roots.

Here is a part description of *H. longistylum* from the *Journal of the Arnold Arboretum,* p18, 1945:"*Epiphytic on beach trees, common, stems numerous on a large tuberous base, irregular in form and varying greatly in size, with an uneven muricate surface pierced by numerous entrance-holes of the small brown ants which inhabit it. Stems 1 m or more long, often galled, the nodes swollen; leaves very thick and fleshy, the veins obscure [visible when dry]; flowers white;* ***fruit yellow****, about 9 mm. long, 4 mm. diameter, with two large white seeds enclosed in mucilaginous pulp. From Guadalcanal Island, there are two collections, which in all details agree with* **Hydnophytum Stewartii** *(sic.) Fosberg,* Lloydia *3, fig5 1940. These are Brass 2548 and Kajewski 2389, one collected at Berande, the other on the Berande River, (Guadalcanal Island) the field notes indicate a plant with branches pendulous from a tumid (swollen) stock inhabited by great numbers of small brown ants; the branches are more than a meter long. Kajewski describes the fruit as cream-coloured, thickest at the base, tapering to a blunt point 8 mm. long 3 mm. in diameter*." *H. stewartii* is therefore a synonym.

Fig. 92 & 93 - *Hydnophytum longistylum* with unusual 'roots', Tunurua mangrove swamp, Bougainville Island. // *Hydnophytum longistylum* – a windfall specimen that will be used for study, Tunurua mangrove swamp, Bougainville Island.

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A few other names have been applied to Solomon Island collections as follows.

H. inerme Cornelis Eliza Bertus Bremekamp published in *Blumea* 5, 245, 1942 and based on two basionyms. The first is *Myrmecodia inermis* Charles Gaudichaud-Beaupré published in *Voyage autour du monde, entrepris par ordre du roi, éxécuté sur les corvettes de S. M. l'Uranie et la Physicienne, pendant les années 1817, 1818, 1819 et 1820; Botanique* 472, 1830.

The second is ***H. gaudichaudii*** Odoardo Beccari published in *Malesia Raccolta* 2, 124, 1884.

I quote (Dr. Guppy, 1887), "*Hydnophytum inerme, a specimen I obtained from Ugi (now Uki) Island at the east end of the group (Solomon Islands) in 1882, and identified by Mr. C. Moore of Sydney*." (Uki Island is at the farthest end of the archipelago from Bougainville.)

However, according to Bremekamp (1942) when more information about hydnophytums was becoming available, "the distribution of *H. Inerme* is from Indonesia's Moluccas Islands to West New Guinea." *H. inerme* is surely a synonym for the quite mundane and very widespread species *H. formicarum* from the Southeast Asian mainland, Indonesia, New Guinea and the Philippines.

Fig. 94 & 95 - Zhon Bosco Miriona, owner of Boug Tours, holding *Hydnophytum kajewskii*. Boug Tours Bosco is also growing myrmecophytes near his small tourist lodge. // *Myrmecodia tuberosa* "salomonensis" near Panguna Mine, Bougainville Island.

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Another name used is ***H. hellwigii*** Otto Warburg published in *Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie* 18, 209, 1894. Type, Papua New Guinea, Morobe, Finschafen (correctly spelt Finschhafen.) I have insufficient information regarding this collection but it is probably not a coastal species.

In conclusion, *H. moseleyanum* has a distribution from Manus Island and the New Guinea mainland south to Cape York Peninsula, Australia. Perhaps it is not impossible that it has been spread by (sea?) birds on mainland and island New Guinea through the Bismarck Archipelago and onward to the Solomon Islands. It is after all a coastal species. However, if the Solomon Islands plants belong in *H. moseleyanum,* they surely deserve some further recognition, if not a taxonomic rank then perhaps *H. moseleyanum* "longistylum".

***Myrmecodia tuberosa* "salomonensis"** is the Solomon Islands form of this enormously widespread species and yes, the above spelling is correct.

Fig. 96 - *Myrmecodia tuberosa* "salomonensis" – a perfect specimen from Bougainville Island.

On the island of New Ireland to the north the form “dahlii” gradually changes to the “salomonensis” form toward the south of that long, very narrow island.

Salomonensis is a particularly robust form of *M. tuberosa* and although there are no similar forms nearby there are very robust forms beyond Australia.

It was a common plant near Arawa in undisturbed vegetation such as mangrove/strand forest growing with all three *Hydnophytum* species. In other lowland regions, it was much less common probably because these areas are heavily cultivated with Coconut plantations and other crops. In addition, the lowlands are heavily overgrown with

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smothering lianas and vines that must offer intense competition to epiphytes especially myrmecophytes. Yet even here, some *Myrmecodias* survived high in the liana free crowns of particularly large, emergent trees.

There was a large variation in tuber surface coverings with some specimens being particularly spiny but others being spineless with some evidence suggesting that this latter trait may be more common in mangrove habitats.

Fig. 97 & 98 - *Myrmecodia tuberosa* "salomonensis", Panguna, Bougainville Island. // A particularly large *Myrmecodia tuberosa* "salomonensis" near Panguna Mine , Bougainville Island.

Fig. 99 - A typical *Myrmecodia tuberosa* "salomonensis" colony in a *Casuarina* tree, Panguna, Bougainville Island.

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Dischidia especially those taxa from remote locations require more field work; therefore, I am extremely hesitant to apply positive identifications to some of the plants I have photographed in the field.

I found *Dischidia* to be much rarer on Bougainville Island than New Britain probably because the side I visited (east) had no pronounced dry season, unlike the Gazelle Peninsula.

Fig. 100 - View from Panguna, Bougainville Island.

I found a small button-leafed species that is very possibly a tiny form of *Dischidia nummularia*, an immensely widespread and variable species. There was also a domed-leafed species that if it is not *D. imbricata* is very similar to it but so are numbers of other *Dischidia* species. This is almost certainly an ant-house species further supported by its occurrence with an ant-orchid *Grammatophyllum scriptum.* Names applied to Solomon Island collections in the past are *D. milnei* Hemsl & *D. melanesica* Fosberg.

Grammatophyllum scriptum [Lindley] Blume, 1849. Is one of the generalist ant-orchids that provide potential nesting sites within their massive root systems but here the ants must build their own homes using ant carton. (See Fig. 4).

Fig. 101 & 102 - *Myrmecodia tuberosa* "salomonensis" from near Panguna mine, Bougainville Island. // *Myrmecodia tuberosa* "salomonensis", Panguna, Bougainville Island. Tuber covering can be very varied, as seen in this spineless high altitude specimen.

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Part six, Central Province, Papua New Guinea.

The independent nation of Papua New Guinea covers the eastern half of New Guinea Island, the second largest island in the world; behind Greenland which is the largest. The western half of New Guinea is currently administered by Indonesia; however, because of a separatist movement, there is sometimes conflict there.

Fig. 103 – Papua New Guinea (GraphicMaps.com)

Papua New Guinea also includes many 'surrounding' islands from Mussau Island (St Matthias group) the most northerly ones, down through the rest of the Bismarck Archipelago (New Ireland, New Britain and outliers.)

Semi-autonomous Bougainville Island and its tiny outliers (Buka Island etc.) are the most easterly islands and are the start of the long Solomon Islands Archipelago. The remaining islands in this archipelago comprise the sovereign Solomon Island nation.

Manus, the main island of the Admiralty group, sits southwest of the St Mathias group in the north. Add in the D'Entrecasteaux islands and especially those of the Louisiade Archipelago that protrude beyond the tip of the Papuan Peninsula off to the southeast and the nation's latitudinal range spans a region from very close to the equator to about 12 degrees south.

Manus Island has been in the news because it is used by Australia for processing asylum seekers arriving in Australian waters by boat. It is also a recorded habitat for *Hydnophytum moseleyanum.* Papua New Guinea

New Guinea is a contrasting land of high mountains and enormous swampy plains with large meandering rivers. There are very few roads and where they do exist they are usually shocking. On the so-called Highlands Highway, I saw one pothole so deep a tall man could stand in it without being seen. To avoid such obstacles, drivers often weave onto the wrong side of the road; consequently head on collisions are not rare. Add to this very scary drop-offs beside roads cut into ludicrously steep mountainsides; means driving is not for the timid. Furthermore local drivers are often chewing betel (a mild euphoric).

Because of the terrain, especially in the more rugged mountain regions, and there are lots of them, many settlements can only be accessed by air (and foot.) Yet the road from Port Moresby to the immaculate Bomana War Cemetery and on to the Kokoda Track (hiking only) was very well maintained. Both places are of enormous historical importance to Australians and it is their funds and their tourists that help to ensure both places have the support they deserve.

Port Moresby (Moresby to the conversant) is Papua New Guinea's capital and it is considered to be one of the most dangerous cities in the world. Surely, one of this nation's largest occupations is security. Unemployment is about

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80% and poverty is rife, so most businesses and the homes of those with sufficient wealth are commensurately fortified. The reality of life in Moresby makes for grim reading: Port Moresby

However, with proper research, due diligence and common sense, one may travel there with less risk, especially if supported by well-chosen local guides and one has the necessary inoculations and travel insurance. Papua New Guinea - Is it safe to go there?

Fig. 104 – Carving, Holiday Inn, Port Moresby, Papua New Guinea.

Mount Hagan in the highlands is the nation's second largest city and has similar problems. Indeed my hotel in Mount Hagen City, Western Highlands Province was protected by a very tall fence with military style control towers at each corner and guards at the entrance 24/7. Most businesses were similarly fortified.

Apart from wild pigs and humans there are no large mammal predators but New Guinea does share with Australia a number of the world's most venomous snakes. I have spent many days in the Australian bush with very little concern for snakes but in New Guinea chances of getting to an antivenene in sufficient time for one to survive are enormously poorer.

Most snakes will move out of the way of humans but adders rely too much on their camouflage and are often inadvertently stepped upon resulting in retaliatory bites to the stepper. A wise precaution is to call out loudly every 50 metres or so "two and two" if there is no reply then obviously there are no camouflaged adders nearby. (This is a little bit of Aussie humour). See also: Snake Bite

In lowland swamps or river sides, populations of *Crocodylus porosus* can be a danger if they have not been eaten by the locals.

Because of these various constraints, it is not surprising that the taxonomy of myrmecophytes in New Guinea and other nearby regions is probably some way from completion.

Dr. Matthew Jebb in his 2009 Internet publication (link below) regarding the 'forthcoming' edition of his *Hydnophytum* revision, states that he recognises 55 species, 22 of which were newly described. We are still waiting!

Of these 55 species, 44 are found in New Guinea; however, until a modern revision is available, many *Hydnophytum* names remain uncertain. Furthermore, I expect that until much more field work is completed in these difficult and dangerous habitats, our understanding of 'myrmecophyte' Rubiaceae and others will remain insufficient.

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Almost certainly, members of the following group have already found probable new species. https://www.facebook.com/groups/myrmecophytes/ See also: Hydnophytum

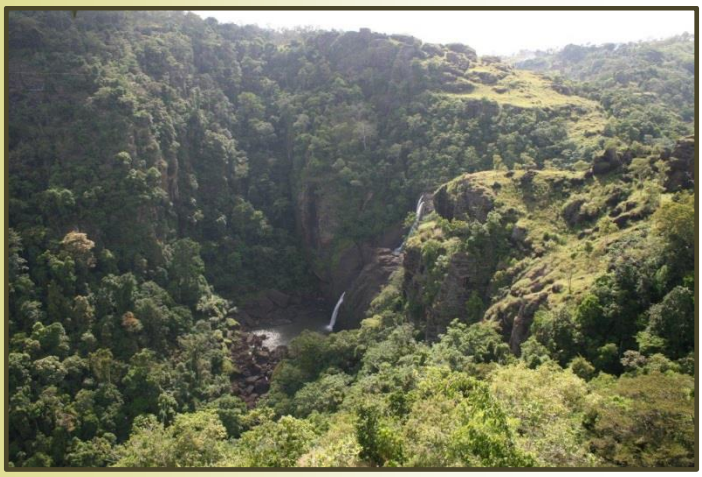

Fig. 105 & 106 - Rouna Falls, Laloki River from Sogeri Road. Central Province, Papua New Guinea. // War monument with Iloilo Rubber Plantation behind. MacDonalds Corner, Sogeri Plateau, PNG.

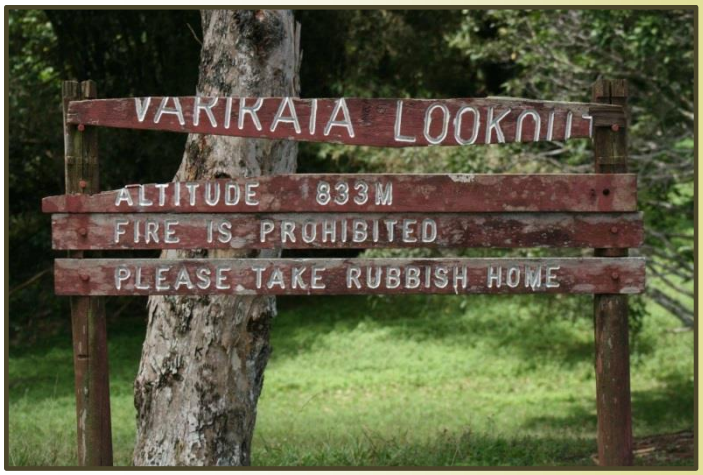

Fig. 107 & 108 - Sogeri Rd. winding up the Laloki River Gorge. Central Province, PNG. // Lookout sign, 833 m. a.s.l., Varirata National Park. Most of the following plants were photographed a little above this altitude in Varirata National Park. Central Province, PNG.

Fortunately, we have somewhat modern revisions for the other myrmecophyte Rubiaceae genera, *Anthorrhiza, Myrmecodia* and *Myrmephytum* but again these may not be final taxonomies.

Some of the fascinating Anthorrhiza species are restricted to Papua New Guinea primarily upon the nearby small islands in Milne Bay Province or on the Papuan Peninsula, (the one that points south east) but I have yet to photograph any of them.

Myrmecodia according to Huxley & Jebb (1993) comprises 26 species but once again this is probably only a snapshot in time of what the genus will finally contain, especially the taxa on New Guinea Island and very possibly some of the many smaller, (monkey-free?) islands in the region, including those in the Philippines. However, with *Myrmecodia,* we do have a better chance of applying more useful names to images.

Port Moresby and its National Capital District will almost certainly be the gateway for visitors. This side of the island lies in the rain shadow of the east west chain of high mountains that dissect New Guinea. Consequently, lands south of the mountains have a distinct tropical dry season lasting from about June to November with a wet season from

December to May. Average annual rainfall is a little over 1 m. (40".) with temperatures remaining relatively constant throughout the year. Average daily temperatures range from 28°C to 32°C, with the dry season having minimums nearer to 26°C.

The lowlands of surrounding Central Province have similar Hydnophytinae to those of nearby Cape York Peninsula in Australia, so were not of an enormous interest, but in the hills behind Port Moresby it became much more interesting. The Sogeri Rd. leaves the Sir Hubert Murray Highway near the airport to wind its way up the picturesque Laloki River Gorge (See Figs. 105 & 107) to the Sogeri Plateau, which is about 46 k from the city and at 600 plus metres above sea level, it is much cooler and greener than the dry-season dusty lowlands.

Fig. 109 & 110 - *Myrmecodia platytyrea* subsp. *antoinii* & *Dischidia nummularia*, Sogeri Plateau, Papua New Guinea. These are the first wild ant-plants seen on a lone tree between the road and agricultural land. // *Myrmecodia platytyrea* subsp. *antoinii*, Ilolo, Sogeri Plateau, PNG.

As one nears the plateau, Rouna Falls are on ones left and shortly afterward a road to the right leads to Varirata National Park. This Park was particularly interesting because it had a number of hydnophyte species very different from the Australian ones I was familiar with. Furthermore, being above 700 to 800 metres it is cooler and wetter again. There are networks of trails, grassy areas and some fine views from an escarpment down to Moresby and the sea. I would have liked to spend a lot more time there.

The next road left, marked by the Kokoda monument, goes to Owers' Corner and the start of the 96 k (62 mi.) Kokoda Track (walking only): Kokoda Track

Crystal Rapids, where one can picnic and swim for a small fee, and Sirinumu Dam are along the next road right, or continue straight ahead to Sogeri. All of these areas are worth exploring for myrmecophytes. Off to ones left is the high ridge of Hombrom Bluff, a habitat of *Hydnophytum moseleyanum*, *Myrmecodia tuberosa* "muelleri", *M. tuberosa* "papuana" and *Dischidia major.*

It was soon after arriving on the plateau that I saw my first specimens on a lone tree between the road and agricultural land (See Figs. 109 & 110). A short drive further along, there were more plants but nothing differing from what one can see in nearby Australia. Yet just mere metres from the entrance to the Kokoda Trail in a stand of tall trees, were some species very new to me (See Figs. 111 & 112).

Fig. 111 & 112 - *Myrmecodia* sp. near start of Kokoda Trail. Note juvenile plant beneath adult. // *Hydnophyum radicans* (??) juveniles or a *Myrmecodia* sp., Ower's Corner road end & start of Kokoda Trail. Central Province, PNG.

Fig. 113 & 114 - Juvenile *Hydnophytum radicans* (large leaves) & *Hydnophytum petiolatum,* above lookout ca. 850 meters, Varirata National Park, Central Province, Papua New Guinea. // A juvenile *Hydnophytum petiolatum*, at the same location.

The 'facilities' in Varirata National Park were quite dilapidated in 2010 as shown by the sign at the 833 m. (2733 ft.) lookout; nevertheless, species new to me soon started to appear.

Just above the lookout a bush track follows the edge of a steep, very high escarpment where most of my Varirata photos were taken.

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In a small, but deep and rapidly descending gully about half an hour's drive back from the National Park there was a colony of truly enormous hydnophytums (see images.) growing with some equally gigantic *Bulbophyllum* orchids. I suspect that these might be *Hydnophytum albertsii* one of only two species I am aware of that have large myrmecodia-like leaves.

The other species, *H. radicans* is not reported to be large and probably has ridged tubers.

Fig. 115, 116 & 117 - - *Hydnophytum petiolatum* above 850 meters, Varirata National Park, Central Province, PNG. Just above the lookout a bush track follows the edge of a steep, very high escarpment where most of my Varirata photos were taken. Species new to me soon started to appear. // Two of a colony of enormous hydnophytums in a tiny stream gully with a house nearby not far from Varirata National Park, Central Province, Papua New Guinea. // Another even larger member of this hydnophytum colony growing on a huge bolder in the same gully alongside the road to Varirata National Park. Here we have leaf (very large), peduncle, flower and fruit (details visible in full sized vew) of these enormous hydnophytums.

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Part seven, Papua New Guinea Highlands.

The highly populated Papua New Guinea highlands were only brought into contact with the outside world about 1933, so it is an incredible adjustment for a Stone Age society to adapt to the modern world. However, their economy is showing substantial annual increases in Gross Domestic Product; therefore, some of what I write here, especially concerning access to some areas may become history. New Guinea is rich in hydrocarbons and minerals, consequently billion dollar projects are opening up ever more regions and investment in roads and their maintenance is continually improving. A multibillion dollar natural gas project lead by Exxon Mobil is planned to start exporting in 2014. Also a planned highway will finally link Port Moresby through the Gulf Province to the Southern Highlands Province and the Highlands Highway. Currently Port Moresby has no road links to any other major cities.

Fig. 118 - Mt Hagan City and Wahgi Valley from Rondon Ridge, Western Highlands Province, PNG.

Mt Hagen and its airport sits at an elevation of 1,677 m (5,502 ft.) in the Western Highlands Province and is a useful gateway for road trips to at least some of the Highlands. Other regions are accessible by air or foot only. This, the third largest city in Papua New Guinea sits in the fertile Wahgi Valley surrounded by extensive agricultural lands and much higher mountains. See also: Mount Hagen

Avi Orchid Garden is near Kuli Pass, which one must pass through if driving the 700 km., Highlands Highway up from Lae (or Madang) on the coast, hence it is on the eastern edge of the city. Here there are many native orchids and lots of other tropical plants, along with some very tame native birds. See also: Avi Orchid Garden

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Fig. 119 & 120 - One of the *Myrmecodia schlechteri* species complex in a coffee plantation but not on a coffee tree. Avi Orchid Garden, Kuli Gap, Mt. Hagen City, Western Highlands Province, PNG. // *Myrmecodia schlechteri* complex, at the same location.

Of a more pertinent interest, perched on some larger trees in the coffee plantation right next door, were some specimens of the ***Myrmecodia schlechteri*** complex of species**.** These were my first highland 'finds' and some were looking rather stressed because there had been little or no rain for about four months (See Fig 120).

The various forms of the *Myrmecodia schlechteri* complex proved to be very common in most areas I visited except at higher altitudes where other species make an appearance. Often specimens can be seen in trees along the Highlands Highway and indeed, along most roads or tracks except at higher altitudes.

Fig. 121 & 122 - *Myrmecodia schlechteri* complex low on Rondon Ridge near Mt Hagen City, Western Highlands Province, PNG. // *Myrmecodia horrida* above 7,000 ft. (2134 m.) Rondon Ridge above Mt Hagan City.

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Rondon Lodge is a relatively new establishment situated up a rough mountain track about a 40 minute bone shaking drive up from the city. It is on Rondon Ridge an extension of the mighty Kubor Range and it is a very expensive place to stay. See also: Rondon Ridge

Fig. 123 - Artifacts, Rondon Ridge Lodge @ 7.000 ft. Western Highlands Province, PNG.

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Alongside lower elevations of the 4WD track (it does not deserve the title road) were more specimens of the ***Myrmecodia schlechteri*** complex. (See images.) Also near the lodge is Joseph's Orchid Garden with an extensive assortment of native species that had the orchid lovers in raptures. Joseph is also an expert on the local wildlife such as when and where to see the stupendously beautiful Birds of Paradise for which New Guinea is justifiably renowned.

Yet perched on a small tree at about head height in amongst the orchids was one of the most unusual plants I have had the fortune to see. It was obviously a *Myrmecodia* and closer examination showed that it was one of a complex of four closely related species that in addition to having the usual tunnel/chamber systems in its tuberous base also have tunnels that run the length of their thick stems to open at spine rimmed alveoli pits toward their tips. I think this specimen was ***M. horrida.*** (See image.) On the WWW one can find numbers of visitor reports about Rondon Lodge, the Birds of Paradise and Joseph's Orchid garden, yet surprisingly no one seems to mention this extremely weird plant.

Fig. 124, 125 & 126 - *Myrmecodia horrida* stem detail with stem entrance upper right. Above 7,000 ft (2134 m.) on Rondon Ridge, near Mt Hagen City, Western Highlands Province, PNG. // *Myrmecodia horrida* tuber detail, at the same location. // *Myrmecodia horrida* stem detail showing spine-rimmed entrance holes, at the same location. On the WWW one can find numbers of visitor reports about Rondon Lodge, the Birds of Paradise and Joseph's Orchid garden, yet surprisingly no one seems to mention this extremely weird plant.

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Rondon Lodge and its orchid gardens are at an altitude of about 2134 m. (7,000 ft.) which is above the heights that *M. schlechteri* occur. Above that altitude were more plants of the *M. horrida* complex growing at medium to high heights in rainforest trees. (See Figs. 122, 124, 125, 126) Some of these plants I suspect were ***M. melanacantha*** or others of the complex but being positioned high in trees, exact identifications are as usual problematic.

From Rondon Ridge there are extensive views over Mt. Hagen City to the mountains beyond (See Fig. 118).

Magic Mountain Nature Lodge is about a 45 minute uphill drive from Mt. Hagen City on the Wabang Road the northern branch of the Highlands Highway. Wabang is in Enga Province, (the highest one,) that is northwest of Mt Hagen City.

As is usual, guests will be picked up from the airport and will be given the very best of hospitality and care. I felt very safe here exploring and visiting the local villagers, accompanied by very helpful local guides who are very aware of the importance of tourism. It is very different in the city where one must be very security conscious.

Fig. 127 - Entrance to Magic Mountain Lodge, Western Highlands Province, PNG

There were high altitudes *Myrmecodia* in the grounds of the lodge and in trees alongside the rather rough road just a short walk away. I suspect that these were *M. melanacantha* (See Figs. 132 & 133).

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Fig. 128 & 129 - A juvenile of the *Myrmecodia horrida* species complex (less robust spines, short petioles) in the grounds of Magic Mountain Lodge, Western Highlands Province, PNG. // Juveniles can be hard to identify but these are probably *Myrmecodia horrida* high on Rondon Ridge.

Fig. 130 & 131 - Mature specimens of the *Myrmecodia horrida* complex taken at dusk on Magic Mountain Lodge Road. // A specimen of the *Myrmecodia schlechteri* complex low on Rondon Ridge, near Mt. Hagan City.

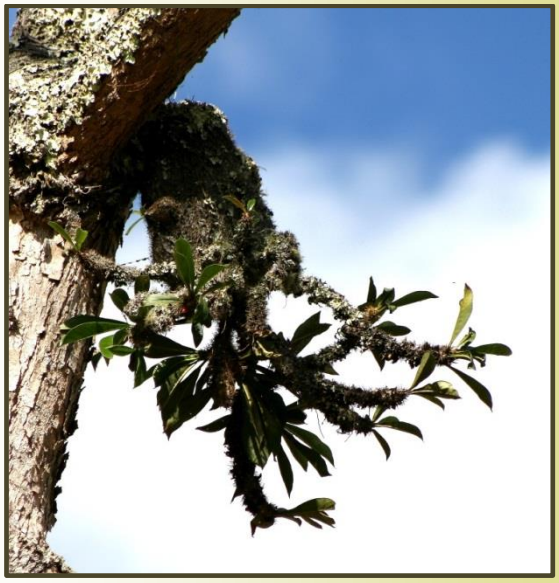

Fig. 132 & 133 - There were high altitude *Myrmecodia* in the grounds of the Magic Mountain Lodge and in trees alongside the rather rough road just a short walk away. I suspect that these were *M. melanacantha*. A very mature colony, probably of the *Myrmecodia horrida* - *melanacantha* group in rainforest well above Rondon Lodge. // Possibly *Myrmecodia melanacantha*, a species with longer finer spines than *M. horrida*, higher on Rondon Ridge.

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Magic Mountain is an isolated peak that having a circular base gives it the same shape from whatever direction it is viewed. However, it is dwarfed by Mt. Hagen that has an altitude of 3778 m. (12,395 ft.) Mt. Hagen can be climbed from the lodge which can supply very experienced guides. One of the guides brought me a *Hydnophytum* tuber that had been found high on Magic Mountain on a fallen tree. Unfortunately, it had no stems or leaves (See images below).

Fig. 134 & 135 - A dissected windfall *Hydnophytum* sp. unfortunately found without leaves or stems, from high on Magic Mt., Western Highlands Province, PNG. // The same windfall *Hydnophytum* sp. The 8x4 inch timbers give scale.

Fig. 136 - *Myrmecodia schlechteri* subsp. *schlechteri* var. *sclechteri* with flowering orchids above Kundiawa on the Keglsugl track, Chimbu Province, PNG.

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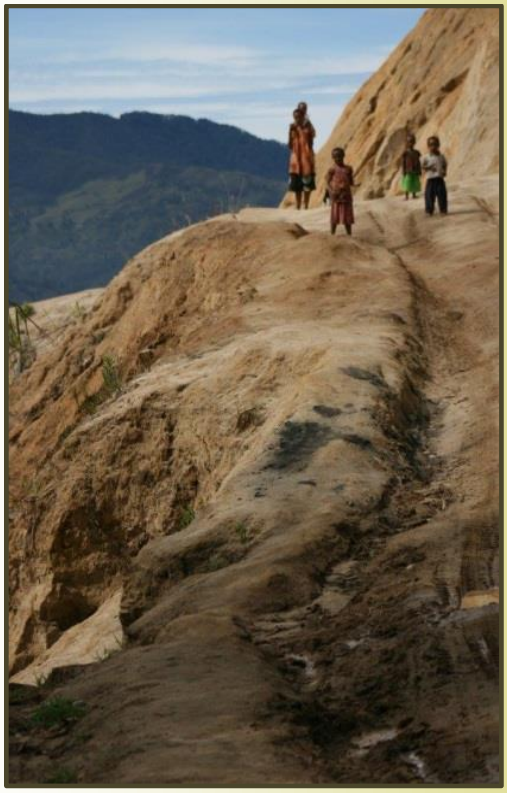
Kundiawa is the capital of Simbu Province (Officially spelt Chimbu) which is about a 1.25 km drive east along the potholed Highlands Highway. Again it is not the most savoury of places but there are *Myrmecodia schlechteri* in the trees around the township. Here one can turn left towards the high altitude settlements of Gembogl (at 2178 m. or 7146 ft.) and Keglsugl (at 2663 m. or 8763 ft.) in the foothills of Mt Wilhelm in the mighty Bismarck Range. Reaching an altitude of 4,509 m. (14,793 ft.) this is the highest peak in Papua New Guinea, some claim in Oceania. Chimbu Province is the second highest Province in Papua New Guinea being only behind Enga Province. Again the track is horrendous in places especially in the wet and is rather scary especially when ones betel nut chewing drivers seem to prefer driving close to the edges of the all too frequent precipices even when they were on the right hand, hence the wrong driving side of the track. Yet there are excellent views, especially along the spectacular Chimbu Gorge (See Figs. 137, 138 & 139).

Fig. 137 - Simbu (Chimbu) Gorge on track from Kundiawa to Gembogl, Keglsugl, Betty's Lodge and even Madang. Chimbu Province, PNG.

Fig. 138 & 139 - The track from Keglsugl to Bundi, Chimbu to Morobe Provinces. PNG. // A slip on the Keglsugl - Bundi section of track. Even in the most difficult places to get to, there were people eking out a living in the forests.



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At lower altitudes there were colonies of *M schlechteri* subsp *schlechteri* var *schlechteri* and probably others of the complex as well. Toward Gembogl these were replaced by specimens of the higher altitude *M. horrida* complex. (See images.) None were seen above Gembogl where the atmosphere becomes ever more tenuous and cooler. I walked from Betty's Lodge down to Gembogl successfully looking for myrmecophytes but the long walk back uphill was rather challenging due to the lack of oxygen. The local people do a lot of walking hence they are very fit, so I was passed by all of them but seeing a woman walking ahead of me in the distance, I decided that trying to overtake at least one person would provide me with an incentive to walk faster. Success at last; I did overtake her, but in fairness I must admit she may have been handicapped by the truly enormous sack of yams she was carrying up the mountain.

Fig. 140 - Mondia Village & Orchid Gardens. This tiny, remote community, living almost as hunter gatherers had protected part of their land as an orchid reserve of which there were not only many but they were scientifically named and labelled. They probably don't get hordes of visitors but the contributions of every visitor helps to improve the quality of life for these hardy people.

Fig. 141 - Plants of the *Myrmecodia horrida-melanacantha* group a little above high altitude Gembogl. Chimbu Province, PNG. At higher altitudes *M schlechteri* subsp *schlechteri* var *schlechteri* were replaced by specimens of the higher altitude *M. horrida* complex.

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The Southern Highlands is the most highly populated Province and it has probably the worst reputation for tribal warfare and violent crime. As usual we travelled with guides but being outside of their own tribal territory (their won tok - one talk language group) they seemed nervous.

The border post was staffed with well-armed police who check all vehicles for contraband, especially guns. We travelled this, the southern branch of the Highlands Highway, as far as the first river crossing past the turnoff to Mendi the Provincial capital. Again there were examples of the ubiquitous *M. schlechteri* complex and at least one specimen of ***M. pendens***, a species characterised by its possession of distinctive white edged ridges on its tubers. (See Fig. 142) However; I was not aware I had photographed this new to me species until I was able to see my images on a large screen.

Fig. 142 & 143 - *Myrmecodia pendens*, above first river crossing (ca. 2361 m altitude) past Mendi turnoff (driving southwest), Southern Highlands Province, Papua New Guinea. (above) // *Myrmecodia* sp. above first river crossing on Highlands Highway beyond turnoff to Mendi Town.

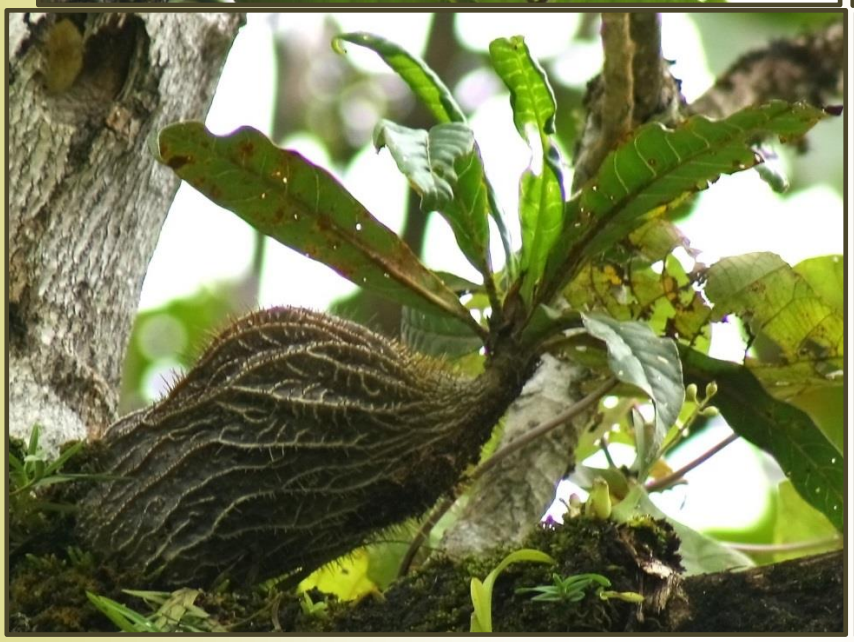

Fig. 144 - *Myrmecodia* sp. near first river crossing past turnoff to Mendi on the Highlands Highway, (going southwest) Southern Highlands Province, PNG.

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Myrmecofitele epifite din Asia de sud și Pacificul de sud-vest

de Derrick J. Rowe, Kopu, Coromandel Peninsula, New Zealand

(abstract)

Lucrarea de față reprezintă o sinteză a experienței acumulate de Derrick J. Rowe (Noua Zeelandă) în ultimul deceniu cu privire la myrmecofitele epifite (plante furnicar epifite) din diverse regiuni ale Australasiei. Primul capitol cuprinde informații esențiale despre biologia, morfologia, ecologia și strategiile de supraviețuire ale myrmecofitelor epifite, precum și o scurtă prezentare a relației simbiontice dintre aceste plante și furnici.

În capitolele următoare sunt prezentate diverse zone geografice explorate de autor (Arhipelagul Fiji, Australia, diverse eco-regiuni distincte ale Papua Noua Guinee – Provincia Centrala, podisurile inalte ale PNG; Insula New Britain, Insula Bougainville) precum și speciile myrmecofite întâlnite, plantele asociate și – nu lipsit de interes pentru cine va dori să viziteze acele locuri – diverse considerații socio-economice utile.

Pe parcursul acestei lucrări sunt menționate și/sau ilustrate numeroase specii de myrmecofite sau de orhidee și ferigi asociate, multe dintre ele extrem de puțin cunoscute și – cele mai multe – complet necunoscute pentru horticultori. În esență lucrarea este cel mai complet set de informații accesibil amatorilor despre această categorie de plante din Australasia.

Fig. 145 - This epiphytic climber is a small button leaved *Dischidia* species. Bougainville Island, Papua New Guinea.

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