Observations On The Flora And Vegetation Of New Caledonia

International Dendrology Society Araucariaceae Symposium Tour

March 2002

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Introduction

The International Dendrology Society hosted a symposium on the Araucariaceae in Auckland, New Zealand, 14-17 March 2002. Included in the event was a pre-symposium tour of Northland, New Zealand, 9-12 March, and a post-symposium tour to New Caledonia, 19-30 March 2002.

The objective of the visit to New Caledonia was to see as many as possible of the five local species of *Agathis* and thirteen of *Araucaria*, both in natural stands and in cultivation, and to gain an appreciation of the other unique conifers and plants of the country.

Features of the New Caledonian flora and vegetation

New Caledonia is an overseas territory of France. The land area is 1 910 500 ha, of which 390 000 ha (20%) is closed forest (381 000 ha natural forest, 9 000 ha *Pinus* plantations), 575 000 ha (30%) is maquis and open forest, 550 000 ha (29%) is savanna, and other vegetation is 395 000 ha (21%) (Schmid 2000). There are c. 3 400 species of higher plants of which 80% are endemic (Dawson 1981; Lowry 1986; Schmid 2000; Jaffré *et al.* 2001). Some 14% of the 840 genera and 5 of the 184 families are endemic.

Floristic relationships have been much studied (Thorne 1965; Morat, Veillon & MacKee 1984), and it is apparent that many groups (such as the gymnosperms, Winteraceae and Cunoniaceae) are remnants of the Cretaceous-Tertiary flora of the ancient, now dispersed continent of Gondwana. In addition, there has been adaptive radiation in many groups since the Eocene after the emplacement of ultramafic rocks, for instance in *Agathis* and *Araucaria* (Setoguchi *et al.* 1998), and in the Araliaceae which has a near-cosmopolitan distribution, but its generic and species diversity is nowhere greater than in New Caledonia. There are a remarkable 43 species of conifer – more than any other even larger areal unit outside of North America and Asia (de Laubenfels 1972, 1996; Jaffré 1995).

The main island, Grande Terre, is a continental fragment once part of Gondwana. About 120 million years ago, Gondwana began to break up. Connections between Africa and South America were broken about 100 million years ago. About 80 million years ago, New Zealand and New Caledonia broke away from the eastern edge of the Australian plate. Finally, about 50 million years ago, Australia separated from Antarctica and began moving northwards. New Caledonia thus became separate from Australasia (Australia, New Zealand and New Guinea) in the early Cretaceous, 65-80 million years ago. It experienced neither the severe aridity of Australia nor the glaciations of New Zealand, allowing many ancient plants to persist. Its rich and unique flora is also explained by the extraordinary evolution of shrub species on serpentine substrates, originating 30 million years ago in the Oligocene.

There are two main types of serpentine soils in New Caledonia – the brown eutrophic hypermagnesian soils, which are rich in magnesium, silica and iron, very low in phosphorus, and are rather neutral (pH 6. 6), and the ferralitic or lateritic soils which are rich in iron oxide, chromium, and nickel, very low in magnesium, and are quite acidic (pH 5. 0) (Brooks 1987; Mueller-Dumbois & Fosberg 1998).

Nickel in New Caledonia occurs as secondary minerals derived from weathering of nickel-bearing ultramafic rocks under a tropical climate, the two types of nickel ore being silicate laterite and oxide laterite. Silicate nickel laterite comprises an upper, earthy, iron-rich zone, and a lower rocky zone known as saprolite in which the nickel occurs in complex Mg-rich silicates, derived from sepentinised peridotite. The main nickel mineral in the silicate laterite is *garnierite* or hydrated nickel silicate $[(Ni,Mg)SiO_3 . nH_2O]$ which is concentrated (2-3%) in the rocky soil overlying the basement serpentine rocks. Oxide nickel laterite, rich in iron does not have much magnesium, and occurs in the Southern Massif on the Goro Plateau (see 24 March notes).

New Caledonia has 47 species which accumulate nickel (Brooks 1987). Those that are extreme accumulators with over 10 000 µg/g (1%) in dried leaves are: *Homalium guillanii* (Flacourtiaceae), *Homalium francii* (Flacourtiaceae), *Hybanthus austrocaledonicus* (Violaceae), *Phyllanthus serpentinus* (Eurphorbiaceae), *Geissois pruinosa* (Cunoniaceae), *Geissois intermedia* (Cunoniaceae), *Psychotria douarrei* (Rubiaceae), and *Sebertia acuminata* (Sapotaceae). The latter species, known as sève bleue, contains a blue sap composed of nearly pure nickel citrate, with 11. 2% nickel in the fresh undried state – by far the highest nickel concentrated ever recorded in any plant.

The main vegetation types are moist evergreen rain forest, induced *Melaleuca* and *Casuarina* woodland or savanna, serpentine scrub or maquis minier (Brooks 1987; Mueller-Dombois & Fosberg 1998; Schmid 2000), and mangroves. The original dry sclerophyllous forest which once covered large parts of the western, rain-shadowed side of Grande Terre, and which included several deciduous tree species, has largely been cleared for cattle ranching (O'Neill 2000). This is where the rare *Captaincookia margaetae* (Rubiaceae) can be found – a beautiful shrub with crimson flowers in streamers up the stems (O'Neill 2000).

In contrast to the Grande Terre, the Loyalty Islands and the Isle of Pines are mainly ancient raised coral

islands though the latter has an ultramafic rock centre and the flora of this calcareous substrate is quite different, with only c. 30% endemism and c. 500 species (Morat, Jaffré & Veillon 2001).

The group

Those on the trip were :

Lachie Andrews (Australia), Elizabeth Banks (UK), Lawrence Banks (UK), Margaret Barker (NZ), Anne Berry (NZ), Bob Berry (NZ), Lance Carr (Australia), Peter Cave (NZ), Keith Clarke (Australia), Sylvia Clarke (Australia), John Dawson (NZ), David de Laubenfels (USA), Janet de Laubenfels (USA), Winfried Golte (Germany), Sean Graham (Canada), Richard Hart (NZ), Joe Havel (Australia), Nicki Higgie (NZ), Clive Higgie (NZ), Diana Howard (NZ), Jim Howard (NZ), Wyne Johns (NZ), Daniel Luscombe (UK), Roland Mecke (Germany), Arnold Phillips (NZ), Graeme Platt (NZ, Tour Leader), Rosemary Platt (NZ), Floris Schalij (Netherlands), Maaike Schalij (Netherlands), Carol Spicer (UK), Derek Spicer (UK), Ruth Stockey (Canada), Wil ten Dam (Netherlands), Barry Tomlinson (USA), Dick van Hoey Smith (Netherlands), Riet van Hoey Smith (Netherlands), Mike Wilcox (NZ).

19 March 2002: Auckland to Nouméa, NZ 62 (B737-300). On arrival the temperature was 28°C, and the weather fine. This city of c. 80 000 people has a mean annual temperature of 23°C, and a rainfall of 1410 mm. The wettest time is January-April and the driest, October to December. We were met by Joseph Manauté of the Parcs et Reserves Terrestres, Province Sud, and Jane Jore of Arc en Ciel, the tour company attending to our arrangements. We travelled by bus to Bourail, with accommodation at the Poe Beach Resort. The coastal plain from the airport northwards has much *Casuarina collina* and niaouli (*Melaleuca quinquenervia*), with abundant ipil (*Leucaeana leucocephala*) and gaïac (*Acacia spirorbis*) on the roadsides. Niaouli forms a kind of savanna or parkland of scattered trees over the grassy hillsides – a vegetation induced by fire. Near Paita and Tontouta, *Acacia nilotica* has become naturalised, where it was originally introduced for cattle fodder. Giant sensitive plant (*Mimosa diplotricha* syn. *M. invisa*), sensitive plant (*Mimosa pudica*), together with blue rat's-tail (*Stachytarpheta urticifolia*), Natal redtop grass (*Melinis repens*), and also Rhodes grass (*Chloris gayana*), both introduced from southern Africa, occur abundantly on roadsides.

We visited the sawmill of Pierre Mathieu at Ouaou, Col d'Amieu, La Foa, Commune of Sarraméa, Province Sud, in the hills. The mill cuts *Pinus caribaea* from local plantations (30%), kaori blanc (*Agathis moorei*) (10%), and various hardwoods, the most valuable ones being houp (*Montrouziera cauliflora)* and tamanu (*Calophyllum caledonicum*). Logs of *Araucaria columnaris* from felled woodlots were also being milled, the timber being used for general carpentry. We inspected a splendid experimental plantation (0. 9 ha) of *Agathis moorei*, 45 years old, with a growth rate of 50 cm per year in height and 0. 83 cm per year in diameter. The form of the trees was exemplary.

The rain forest, growing at 400 m, 2500 mm rainfall, is 20 m tall. There were many trees of the Cunoniaceae, *Archidendropsis granulosa* – a tall leguminous timber tree, and several ferns (some familiar to New Zealanders), such as *Sticherus flabellatus, Dicranopteris linearis, Gleichenia brackenridgei, Gleichenia dicarpa, Blechnum corbassonii* (rather like *B. novae-zelandiae*), *Bolbitis palustris, Leptopteris wilkesiana* (with a slender 1-2 m trunk) and tree ferns - *Cyathea intermedia* and *C. novaecaledoniae* – which drop their fronds cleanly. The giant elephant fern (*Angiopteris evecta*) was common and caught the attention of everyone, and the large *Marattia attenuata* was also present. *Myodocarpus fraxinifolius* (Araliaceae) was a prominent small tree with a slender stem, and leaves clustered at the top.

At Poe Beach there was a typical Pacific strand vegetation with *Acacia simplex, Casuarina equisetifolia, Cerbera manghas, Thespesia populnea,* burao (*Hibiscus tiliaceus*), and *Scaevola sericea*. Common ornamentals at the Poe Beach resort were *Hibiscus tiliaceus*, Jamaican cherry (*Muntingia calabura*), butterfly bush (*Bauhinia purpurea*), yellow oleander (*Thevetia peruviana* syn. *Cascabela thevetiana*), *Acropogon (Sterculia) bullatus*, and curtain fig (*Ficus microcarpa* var. *hillii*).

Prominent roadside grasses in the hills were the introduced giant reed or grand roseau (*Arundo donax*), *Miscanthus floridulus*, and Guinea grass (*Panicum maxima*). *Bambusa vulgaris* forms large clumps with handsome arched culms in some valleys. A common wayside tree is candle nut (*Aleurites moluccana*), and yellow guava (*Psidium guajava*) has colonised grassy slopes. *Schinus terebinthifolius* is abundant in places, forming roadside thickets, and both castor oil (*Ricinus communis*) and tobacco weed (*Solanum mauritianum*) are frequent. Rubber vine or liane de Gatope (*Cryptostegia grandiflora*: Asclepiadaceae) is a tall climber from Madagascar and East Africa that has invaded disturbed sites (Lowry 1996).

20 March 2002: We visited Parc du Lagon de Bourail, Baie de Tortues, to see a startling stand of *Araucaria columnaris*. The population comprises some 300 trees, with heights of 42 m. No regeneration was evident. Associated plants were *Pandanus tectorius, Cycas seemannii, Planchonella cinerea, Excoecaria agallocha*, noni or fromager (*Morinda citrifolia*), and *Cupaniopsis* sp. *Cycas seemannii* (called *C. celebica* in Jaffré *et al.* 2001) is the only cycad native to New Caledonia and is limited to strand lines and littoral forests. It also occurs in Tonga, Fiji, and Vanuatu (Hill, K. 1996). A spectacular hole through the coastal rock (Roche Percée) is an added attraction.

At Petit-Couli, we were privileged to visit a local Kanak garden, fringed with *Araucaria columnaris*. This tall columnar tree has been widely planted in villages

throughout New Caledonia. On the road across from La Foa to the east coast, we stopped to view a population of *Araucaria biramulata* on very steep slopes. They stood out prominently above the general vegetation. Roadside banks had colonising faux teck (*Carpolepis laurifolia*), and the forest margins had much *Alphitonia neocaledonica*, a *Weinmannia*, and trees of the Apocynaceae.

Nickel mining was evident everywhere, and at times the road followed the route of the 11 km-long conveyor belt which carries the nickel ore down to the western coast to Thio. It is refined into ferro-nickel matte at the SLN (La Société le Nickel) Doniambo smelter in Nouméa. We inspected a small population of *Araucaria scopulorum* on a rocky site near a river. This is one of the shortest species in the genus. *Araucaria montana* could be seen high up on ridges. Wayu (*Gymnostoma chamaecyparis*) was very prominent in the maquis minier vegetation on ultrabasic soils, together with *Dracophyllum ramosum*, *Grevillea exul* (generally white flowers), *G. gillivrayi* (rosy-coloured flowers), *Geniostoma, Xanthostemon*, and *Geissois*.

On ultrabasic hills with laterite nodules (red soil) we encountered an amazing population of *Araucaria rulei*. In one spot we observed the very curious *Dacrydium araucarioides* with its araucaria-like foliage. It is just a small tree, 4- 6 m tall. Fernland of bracken (*Pteridium esculentum*) and *Dicranopteris linearis* was prevalent on the higher slopes – a consequence of degradation of the maquis vegetation by fire and mine spoils (Mueller-Dombois & Fosberg 1998).

We returned to Poe Beach over the range from Houaïlou, which is a coastal town on the western side, and in Province Nord. Lychee (*Litchi chinensis*) is grown quite extensively in this area. Further up the east coast, especially in the Hienghène district, coffee is an important cash group. The traditional food crop is the yam (*Dioscorea alata*), though taro and cassava are also still grown. At the Col des Rousettes on rather dry ridge crests at c. 450 m there are some 20 m-tall stands of *Nothofagus aequilateralis*, sometimes coexisting with emergent *Agathis moorei* on soils derived from metamorphic rocks (Dawson 1966; McQueen 1983).

21 March 2002: The weather continued fine and warm. We travelled north from Bourail to Poya, and then to the Kopéto mine of Le Nickel – SLN on the Boulinda Massif, where silicate nickel laterite is mined. At 760 m we encountered again *Araucaria rulei*, growing as the only tree above typical ultrabasic maquis and short forest. *Gymnostoma* is particularly abundant on rocky slopes. Beside the road were clumps of *Joinvillea plicata*, a curious monocot regarded as the closest plant to the grasses. The mining company plants *Casuarina collina, Acacia spirorbis*, and *Alphitonia neocaledonica* for stabilisation of roadsides. All three species are nitrogen-fixing.

At c. 900 m there was a fine population of *Araucaria biramulata* growing emergent above a mixed hardwood canopy (20 m tall), but which included *Podocarpus sylvestris* and *Falcatifolium taxoides*, and large, impressive trees of *Gymnostoma poissonianum* and *Montrouziera*. Pitcher plant (*Nepenthes vieillardii*) and fan fern (*Schizaea dichotoma*) were common. In the understorey were shrub species of *Zygogynum* (Winteraceae) and *Styphelia* (Ericaceae). At 1000 m *Araucaria montana* occurs on ridge tops, appearing in the distance prominently on the skyline.

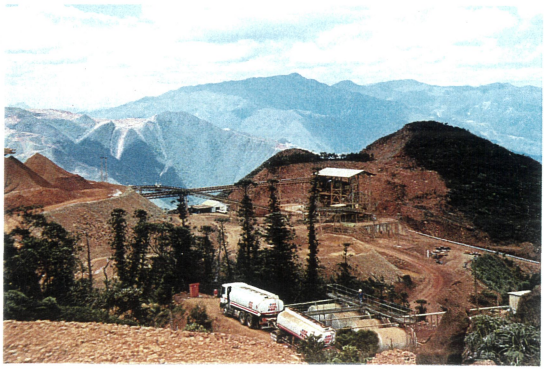
At 1000 m on Mont Kaala a population of *Araucaria montana* was visited, overlooking the rock-crushing plant. A feature of this species was the good regeneration that is occurring, despite it being precarious on account of the mining. The soils seemed to be acid, judging by the presence of plants such as *Gleichenia dicarpa, Sticherus flabellatus, Lycopodium deuterodensum*, bracken (*Pteridium esculentum*), and various sedges such as *Schoenus, Lepidosperma perteres* (rhizomatous, and resistant to fire), *Baumea deplanchei* and *Costularia arundinacea*. Shrubs to attract attention were *Bikkia macrophylla* (Rubiaceae), with large red lantern flowers, *Exocarpos neocaledonicus* (Santalaceae), *Metrosideros francii*, and *Cunonia lenormandii*, with pink flowers.

The commonest roadside trees at lower elevations are *Pinus caribaea, Eucalyptus camaldulensis, E. grandis*, and *E. robusta*.

22 March 2002: We visited the New Zealand war cemetery at Bourail. Trees of note here were golden shower (*Cassia fistula*), appleblossom shower (*Cassia javanica*), and *Eucalyptus saligna*. On one tree we noticed the introduced climbing cactus, *Hylocereus undatus*.

We were all transported by utes and minibuses to the botanical reserve on top of Mont Do, alt. 1150 m, on ultramafic bedrock. The vegetation on the way up was short maquis with fern and sedges, without trees. The summit is a cool, cloudy place with an annual rainfall of c. 1690 mm. *Nothofagus codonandra* occurs here in montane forest in association with emergent *Araucaria laubenfelsii* – a classic site for this conifer where it is regenerating itself freely in the absence of disturbances such as fire, and the subject of some recent ecological studies (Rigg *et al.* 1999; Enright *et al.* 2001; Perry *et al.* 2001). The surface soil is very acidic, with a pH of c. 3. 9. Other trees or shrubs in the forest include *Cunonia montana, Falcatifolium taxoides*, and *Phelline lucida* (Phellinaceae).

Much of the vegetation on Mont Do is maquis, sometimes with emergent *Araucaria laubenfelsii*, with the main shrub species being *Dracophyllum ramosum, D. verticillatum* and *Styphelia cymbulae* (Ericaceae), *Scaevola balansae* and *S. beckii* (Goodeniaceae), *Babingtonia leratii, Metrosideros nitida* and *Tristaniopsis glauca* (Myrtaceae), *Symplocos montana* (Symplocaceae), *Rapanea diminuta* (Myrsinaceae),



Mt Kaala, Kopéto Mine of Le Nickel -SLN, *Araucaria montana*, 1000 m, on Boulinda Massif. 21 March 2002.

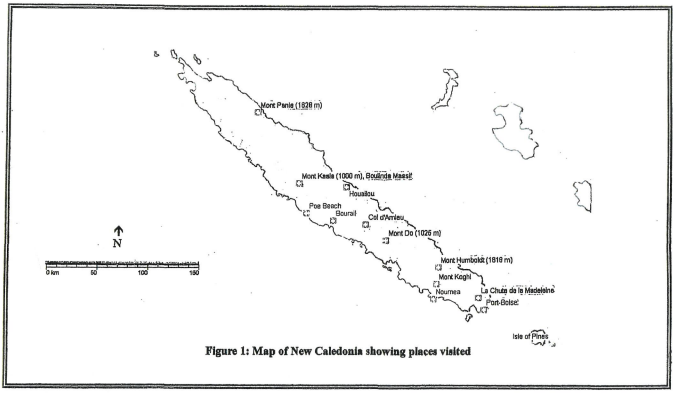
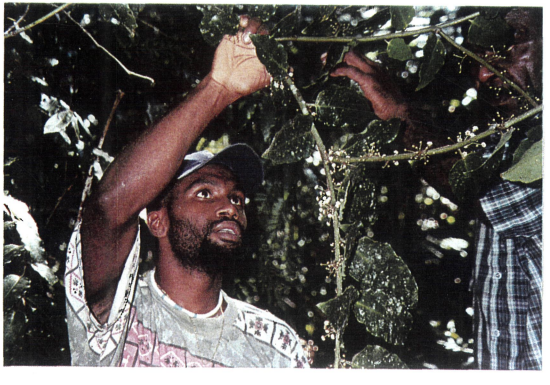


Figure 1: Map of New Caledonia showing places visited

***Agathis ovata*, Yaté Col. 24 March 2002.**

La Chute de la Madeleine, Plaine des Lacs - a classic site for New Caledonian conifers. Growing here are *Retrophyllum minus*, *Dacrydium guillauminii*, *D. araucarioides*, *Neocallitropsis pancheri*, and *Podocarpus novaecaledoniae*. Nearby can be found *Agathis ovata* and *Araucaria bernieri*. 25 March 2002.

Gymnostoma deplancheanum stand, merging into maquis vegetation, La Chute de la Madeleine. 25 March 2002.



Amborella trichopoda, an understorey shrub in rainforest. Col d'Amieu. The most ancestral of all woody flowering plants. 29 March 2002.

Houp (*Montrouziera cauliflora*), one of the biggest trees in the New Caledonian rainforest. Col d'Amieu. 29 March 2002.

Pin colonnaire (*Araucaria columnaris*) at Parc du Lagon de Bourail, Baie de Tortues. The scrub on the hillside is dominated by the introduced legume *Leucaena leucocephala*. The rocks are sedimentary. 20 March 2002.

Pin colonnaire (*Araucaria columnaris*), Isle of Pines. G. Platt. 28 March 2002.

***Araucaria humboldtensis* on Mt Humboldt, emergent above evergreen montane rainforest. G. Platt. 29 March 2002.**

Sean Graham and Roland Mecke looking for insects on *Araucaria columnaris*, Yaté coast. 24 March 2002.

***Araucaria muelleri*, emergent above maquis, Goro Plateau. G. Platt. 28 March 2002.**

Araucaria rulei **emergent above maquis, between Col d'Amieu and Houaïlou.**

Parasitaxus ustus **(Podocarpaceae), Mt Koghi. The host plant for this parasite is** *Falcatifolium taxoides*. **27 March 2002.**

A big kaori (*Agathis lanceolata* **), Parc Provincial de la Rivière Bleue. Height: 40 m; DBH: 270 cm. 23 March 2002.**

Araucaria scopulorum **beside a rocky stream, between Col d'Amieu an Houaïlou.**

Podocarpus sylvestris (Podocarpaceae), *Codia discolor* and *Cunonia montana* (Cunoniaceae), *Myodocarpus fraxinifolius* and *Polyscias pancheri* (Araliaceae), *Wikstroemia indica* (Thymeleaceae), *Hibbertia emarginata* (Dilleniaceae), *Ascarina rubricaulis* (Chloranthaceae), and the fern *Sphenomeris deltoidea*. The lichen *Cladina confusa* was prominent on the ground, with *Lycopodium deuterodensum*, *Schizaea*, and *Cheilanthes*, and the sedge *Costularia arundinacea* was abundant. We all enjoyed our baguettes for lunch on the summit.

All five species of *Nothofagus* in New Caledonia occur in the cool upper montane forests with high, evenly-distributed rainfall (Read *et al.* 1995), and belong to the subgenus *Brassospora*, elsewhere occurring only in New Guinea (Hill, R. 1996).

Our group visited the nursery centre and complex at Port-Laguerre (alt. 30 m), some 30 km north of Nouméa, operated by Service des productions végétales et forêts, Direction du développement rural, Province Sud. Our chief guide was Thierry Azaïs. This is the old CIRAD- Forêt base, where much research has been done on species introduction. Some fine old trees can be seen here, notably teak (*Tectona grandis*), mahogany (*Swietenia macrophylla*), kapok (*Ceiba pentandra*), and *Podocarpus subtropicalis* – a rare species native to Mt Emei, Sichuan, China, but according to David de Laubenfels is frequently cultivated (as *P. neriifolius*).

Some 19 000 seedlings are grown. The main species are *Casuarina collina*, *Acacia spirorbis* and *Alphitonia neocaledonica* for revegetation of mined areas, and *Pinus caribaea*, sandalwood (*Santalum austro-caledonicum*), bois de rose (*Thespesia populnea*), bois bleu (*Hernandia cordigera*), and *Swietenia mahogani*. Of the Araucariaceae, all local species except *Araucaria scopulorum* and *A. subulata* are cultivated. The main *Agathis* species are *Agathis moorei* and *A. lanceolata*. Curiously, it is *A. moorei* that has long, lanceolate leaves, those of *A. lanceolata* being more bluntly ovate. The most striking *Araucaria* was *Araucaria muelleri*. This species has large, flattened leaves resembling *Araucaria* sens. str. *Araucaria nemorosa* has fine, feathery foliage. Cross grafting has been done in an endeavour to have some of the less accessible species available for seed collection. Examples of these were *Agathis corbasonnii* on *A. moorei*, *Agathis montana* on *Araucaria columnaris*, *Agathis montana* on *Agathis moorei*, *Agathis montana* on *Agathis corbassonii*, and *Agathis montana* on *Araucaria rulei*.

At the government headquarters in Nouméa we were accorded a reception by the Province Sud government, with a welcome from Jean-Claude Briault, 3rd Vice-President of Province Sud, and had the opportunity to meet some local botanists, notably Tanguy Jaffré and Jean-Marie Veillon of Laboratoire de Botanique et cologie Appliquées, Institut de recherche pour le développement (IRD), and other invited guests including Paul de Dekker, President of the University of New Caledonia, Hilary Shekleton, Great Britain Consul-general, and Cécile Hillyer, New Zealand Consul-general. Accommodation at the Parkroyal Hotel, Nouméa.

23 March 2002: This was a somewhat wet day, our travels taking us some 60 km out to the Parc Provincial de la Rivière Bleue (9045 ha, estab. 1980) in the Grand Massif du Sud. Much of the land has been degraded by mining and logging. A planting scheme on maquis land at Ouenarou of 110 ha has resulted in plantations of *Agathis ovata* (pl. 2000), *A. lanceolata* (1964, 1986, 2000), *A. moorei* (1959), *Araucaria muelleri* (2000), *A. nemorosa* (2000), *A. columnaris* (2000), *A. subulata* (1986), pommaderis (*Alphitonia neocaledonica*), gum oak or chêne gomme (*Arillastrum gummiferum*), faux noyer (*Neoguillauminia cleopatra*: Euphorbiaceae), and *Acacia spirorbis*. *Pinus caribaea* plantations have done very well on better soils, but very poorly on degraded sites. There are some nice plantations of the main kauri in this region, *Agathis lanceolata*.

At the Ouenarou Forest headquarters are demonstration plots of the *Araucaria* species planted 1980/81, with *Araucaria laubenfelsii* looking particularly good. The two species with the coarsest foliage are *Araucaria muelleri* and *A. rulei*. A grafted seed orchard of *Agathis lanceolata* dates back to Michel Corbasson (1957-58). Old trees here include *Eucalyptus grandis*, *E. microcorys*, *E. botryoides*, *Acacia mangium*, *Corymbia citriodora*, *Paraserianthes falcataria*, and *Elaeocarpus angustifolius*.

The rain forest is very species-rich, and has emergent *Araucaria bernieri*, and both *Agathis lanceolata* and *Agathis ovata*. A huge kaori (*A. lanceolata*) has been retained, and is a famous tourist attraction. *Dacrydium araucarioides*, *Libocedrus yateensis*, *Podocarpus novae-caledoniae* (seen on a river bank), and *Gymnostoma webbiana* are sprinkled through the forest. Other trees noted were *Symplocos arborea*, *Hibbertia lucens*, *Scaevola balansae*, pomaderris (*Alphitonia neocaledonica*), *Cerberiopsis candelabra*, *Beccariella sebertii* (Sapotaceae), *Meryta coriacea*, *Myodocarpus fraxinifolius*, *Garniera spathulaefolia* (Proteaceae), azou (*Bureavella wakere:* Sapotaceae), *Crossostylis* (Rhizophoraceae), the strongly buttressed *Sloanea koghiensis*, *Cryptocarya transversa*, *Fagraea berteroana*, *Geissois hirsuta*, *Hybanthus neo-caledonicus*, and *Pandanus pancheri*. Palms were common – *Actinokentia divaricata*, *Basselinia gracilis*, *B. pancheri*, *Brongniartikentia vaginata*, *Burretiokentia grandiflora*, *Campecarpus fulcitus*, *Chambeyronia macrocarpa*, and *Cyphokentia macrostachya* (Hodel & Pintaud 1998).

Pitcher plant (*Nepenthes vieillardii*) abounds here on the forest floor, with *Joinvillea plicata* and *Lomandra insularis* with a strange tufted shape on a short trunk. A common low climber on tree trunks was *Freycinetia graminifolia* (Pandanceae). A plant was located of the root parasite *Daenikera corallina* (Santalaceae), and

near it, examples of *Dacrycarpus vieillardii*, *Dacrydium lycopodioides*, *Prumnopitys ferrugineus*, and *Retrophyllum comptonii*. A beautiful flowering shrub on a riverbank was *Xanthomyrtus myrtifolia*, together with *Podocarpus novae-caledoniae*, forming low bushes. The hemi-parasite *Amyema scandens* was observed on *Agathis ovata*.

The unusual bird, the kagu or cagou (*Rhynochetos jubatus*) can be found here, frequenting picnic sites. It is a flightless member or the order Gruiformes (cranes, rails, coots) and is the sole member of the family Rhynochetidae.

24 March 2002: Today we travelled south from Nouméa, and visited some maquis areas on degraded mined sites. Prominent shrubs were *Cloezia buxifolia*, with small yellow flowers, *Codia obcordata*, and *Xanthostemon aurianticum*. There is much *Gymnostoma* woodland in this area.

At Col de Yaté there is a marvellous population of *Agathis ovata* growing at 400 m on lateritic slopes. The trees are squat, 6-9 m tall, with flat-topped crowns, and the bark is thick and deeply fissured – perhaps an adaptation to fire. This species is only found in the south of the country in isolated small stands at 150-1150 m elevation on gravelly lateritic soils, and it commonly grows emergent above maquis scrub - as on this site - or in closed forest as observed the previous day. Mature trees at Col de Yaté are estimated to be c. 400 years old (Enright & Goldblum 1998). Another distinctive feature of this species is the white, waxy male catkins. Growing also on this site was much native bamboo (*Greslania montana*), *Gymnostoma deplancheanum*, *Dacrydium araucarioides*, and a bushy *Podocarpus* which David de Laubenfels will be describing as a new species. A common ground fern was *Stromatopteris moniliformis* (Gleicheniaceae).

On the coast at Yaté, which has a much wetter climate than Nouméa's, the Melanesian villages have some tropical fruit trees such as mango (*Mangifera indica*), jak fruit (*Artocarpus heterophyllus*), papaya (*Carica papaya*), and breadfruit (*Artocarpus altilis*), but these do not seem in New Caledonia to be as commonly grown as in other parts of the Pacific. We encountered for the first time a natural stand of *Araucaria columnaris*. It was growing on a steep rocky headland, and with it were pandanus (*Pandanus tectorius*), *Planchonella cinerea*, and pomaderris (*Alphitonia neocaledonica*). The *Araucaria columnaris* trees here generally had straight trunks, in contrast to the typically bent trunks in the Isle of Pines populations.

On the ironstone cap of the Goro Plateau we visited a site of *Araucaria muelleri*. It was growing here with *Dacrydium araucarioides* and *Gymnostoma deplancheanum*, together with various broadleaved shrubs, including *Eugenia*, *Psychotria*, *Solmsia calophylla* (Thymelaeaceae), *Styphelia pancheri*, and *Dracophyllum ramosum*. The sedge *Costellaria* was frequent. We were joined here by Stefane McCoy, a local botanist (ex Australia), working as an ecologist for INCO (International Nickel Company of Canada), based on the Goro Plateau. McKoy has made extensive studies of the fire ecology in this area (McKoy *et al.* 1999). Dr Neal Enright of Melbourne University is undertaking population studies of this relict stand of *Araucaria muelleri*. The trees are thought to be at least 350 years old. They are only 5-10 m tall, and grow virtually on pure iron ore (pH 5-6). The indurated laterite or iron "carapace" gives a strange moonscape – like a lava flow, and the maquis is quite stunted and sparse. A stream had a small population of the rheophytic podocarp *Retrophyllum minus* (syn. *Nageia minor* or *Decussocarpus minus*). The site is also ironstone, subject to periodic flooding.

The Goro Plateau nickel mining operation is based on oxide laterite (in contrast to the silicate laterite of the Koniambo Plateau). The richest nickel-bearing layers generally lie at least 10 m below the surface layers which are predominately limonite (hydrated iron oxide). These iron-rich and nickel-rich layers also have a considerable amount of cobalt, but a much lower magnesium content than the silicate laterite.

A further coastal site was visited at Port-Boisé, with *Araucaria columnaris* growing with some interesting coastal trees, including bo-oupe (*Serianthes calycina*) – a large leguminous tree with reddish flowers, candelabra tree (*Cerberiopsis candelabra*), the remarkable *Eugenia bullata*, tree heliotrope (*Argusia argentea*), blue vitex (*Vitex trifolia*), *Pandanus tectorius* (with prominent stilt roots), and *Hernandia nymphaefolia*. *Cerberiopsis* is peculiar in that it is monocarpic – that is, it dies after flowering. There were local patches of mangrove (*Rhizophora stylosa*), and oriental mangrove (*Bruguiera gymnorhiza*). Inland were small stands of the rare *Araucaria nemorosa* (Waters 2002) growing within rain forest with much *Tristaniopsis* – a conspicuously smooth-barked tree. *Araucaria nemorosa* seems to be a shade-tolerant species. Secondary forest margins had much *Commersonia bartramii* (Sterculiaceae), and *Homalium austrocaledonicum* (Flacourtiaceae), and a nice example was found of the parasitic plant, *Korthalsella disticha*.

25 March 2002: We started today's excursion by inspecting a stand of *Araucaria luxurians* on the coast south of Nouméa near Plum and Mont Dore, but there was some discussion that the trees might be *A. laubenfelsii*. This locality has been colourfully described by David McInnes-King (2000). Inland, there are quite extensive plantations on the Plaine des Lacs of *Pinus elliottii* and *Pinus caribaea*. Some have done well, but others show signs of extreme nutritional imbalance. At Champ de Bataille *Agathis lanceolata* had here been planted under a nurse crop of *Paraserianthes falcataria*, and looked vigorous and healthy. There were also successful plantations of chêne gomme (*Arillastrum gummiferum*). On steep, bush-clad slopes

there were emergent *Araucaria bernieri*, and some *Agathis lanceolata* – both genera in the same stands.

A rocky river-bank site was visited, featuring *Neocallitropsis pancheri*. The trees were 2-4 m tall, and there was also a great deal of *Gymnostoma deplancheanum*, and *Dacrydium araucarioides* in the vicinity, plus the usual suite of broadleaved maquis trees – *Alphitonia neocaledonica*, *Alstonia coriacea*, *Beccariella sebertii* (recognised in the field by the leaves with prominent veins and brownish fulvous pubescence on the young leaves), *Dracophyllum involucratum*, *D. verticillatum*, *Grevillea exul*, *Styphelia cymbulae*, *Xanthostemon aurantiacus*, *Tristaniopsis glauca*, and *Lomandra insularis*.

We visited the Coro Nickel revegetation nursery with Stefane McCoy. Numerous local trees are being grown in polybags, for planting out on land scraped for mining. Two species that seem to transplant out and grow on particularly well are *Gymnostoma deplancheanum* and *Grevillea exul*. Species cultivated are *Myodocarpus fraxinifolius* (Araliaceae), *Comptonella drupacea* (Rutaceae), *Syzygium ngoyense* (Myrtaceae), *Osmanthus austrocaledonicus* (Oleaceae), *Arillastrum gummiferum* (Myrtaceae), *Cunonia deplanchei* (Cunoniaceae), *Xanthostemon aurantiacum* (Myrtaceae), *Beauprea gracilis* (Proteaceae), *Solmsia calophylla* (Thymeleaceae), *Austrobuxus carunculatus* (Euphorbiaceae), *Guettarda eximia* (Rubiaceae), *Ilex sebertii* (Aquifoliaceae), *Guoia villosa* (Sapindaceae), and *Archidendropsis granulosa* (Fabaceae: Mimosoideae).

At La Chute de la Madeleine botanical reserve, Plaines du Lacs, there was a remarkable assemblage of conifers – *Agathis ovata*, *Retrophyllum minus*, *Neocallitropsis pancheri*, *Podocarpus novae-caledoniae*, *Dacrydium araucarioides*, and *D. guillauminii*. Freshwater marshes here and throughout the Plaine des Lacs are dominated by *Xyris pancheri* (Xyridaceae) – an endemic rush-like monocot, and *Schoenus brevifolius* (Cyperaceae), and several shrubs were also present, such as *Melaleuca brongniartii*, *Babingtonia leratii* (formerly *Baeckea ericoides*), *Xanthostemon aurantiacum*, *Homalium kanaliense*, *Cloezia aquarum* and *Pancheria communis*. The herbaceous layer, which is absent on gravelly soil but continuous on alluvial soil, comprises the Cyperaceae *Costularia xyridiodes*, *Schoenus brevifolius*, *Chorizandra cymbaria* and *Tricostularia guillauminii*, and *Xyris pancheri* and *X. neocaledonica* of the Xyridaceae. A curious aquatic fern, *Blechnum francii*, grows underwater. A favourite plant for the photographers here was *Oxera inodora* – a member of the Lamiaceae (formerly Verbenaceae) with white flowers, one of the petals forming a frilly lip.

26 March 2002: This day we visited Mont Koghi (also known as Monts Khogis, as there are several peaks) on the outskirts of Nouméa, but the weather was rather wet. At the auberge there are penned Javan rusa deer (*Cervus timorensis russa*) – a mammal introduced long ago to New Caledonia from Java, and now numbering c. 120 000 head. The Galatea herd of rusa deer in New Zealand is of New Caledonian stock, from an introduction made in 1908.

Mont Koghi has some splendid rain forest, rather reminiscent of the New Zealand bush. Prominent big trees here are houp (*Montrouziera cauliflora*), arbre du Koghi (*Sloanea koghiensis*) with huge plank buttresses and bullate leaves, bois tabu (*Fagraea berteroana*), bois d'ail (*Dysoxylum bijugum*), tamanu du sud (*Calophyllum montanum*), chene rouge (*Cunonia* spp.), *Alstonia plumosa* (plentiful at the Auberge), azou (*Bureavella wakere*), cerisier bleu (*Elaeocarpus angustifolius*), azou graines bleues (*Elaeocarpus speciosus*), bois bleu (*Hernandia cordigera*), and faux acajou or goudronnier (*Semecarpus atra*) – a much feared, toxic tree. *Hernandia cordigera* is a commercial timber species, and one of the trees used locally for making canoes (pirogues). There were common smaller trees of the Araliaceae (*Schefflera* and *Myodocarpus*), impressively tall tree ferns (e. g. *Cyathea novae-caledoniae*), *Marattia attenuata*, several palms (*Actinokentia divaricata*, *Burrretiokentia koghiensis*, *B. viellardii*, *Campecarpus fulcitus*, and *Chambeyronia macrocarpa* – Hodel & Pintaud 1998), extensive stands of *Melaleuca quinquenervia*, tangles of umbrella ferns (*Dicranopteris linearis*, *Gleichenia dicarpa*), the club-moss *Lycopodiella cernuum*, and the curious fern, *Dipteris conjugata*. Ferns and also *Selaginella hordeiformis* are numerous on the ground, but there seem to be no or few herbaceous dicots – a constant feature of all forest and maquis sites we have visited. The only member of the Melastomataceae in New Caledonia – *Melastoma denticulatum* – is found commonly in this area.

Four of our group – Daniel Luscombe, Lachie Andrews, Lance Carr and Derek Spicer – ventured high up into the mountain and located some populations of *Falcatifolium taxoides*, and then its root parasite, *Parasitaxus usta*. On high rocky bluffs grows *Xeronema moorei*.

At the Nouméa Botanical Garden we took the opportunity to view a fine display of the New Caledonian Araucariaceae, and many other species.

27 March 2002: A second group – Ruth Stockey, Sean Graham, Wyne Johns, and Mike Wilcox – went back to Mont Koghi and re-located the population of *Parasitaxus usta* above the Cascades, parasitic on *Falcatifolium taxoides*. It is the only known parasitic gymnosperm. It grows up to 2 m tall, is of a dark wine-red colour, with abundant glaucous cones. It lacks roots and grows directly out of the roots or lower trunk of its host (Kopke, Musselman & de Laubenfels 1983). *Pandanus* was plentiful in this locality, and the fern *Blechnum obtusatum* grew abundantly in the rocky stream course. Other plants noted along the way were *Oplismenus hirtellus* (Gramineae) in forest, *Agathis lanceolata*, strangler fig (*Ficus* sp.), another fig with dense bunches of small cauliflorous fruit on the lower

trunk (*Ficus racernigera*), *Joinvillea plicata, Montrouziera verticillata, Styphelia, Dracophyllum, Acsmithia pubescens, Grevillea, Metrosideros*, and *Cunonia macrophylla*.

Other members of the group visited the Tijabaou Cultural Centre at Tina on the outskirts of Nouméa. It was designed by Renzo Piano. John Dawson gave a lecture in the evening on the vegetation and flora of New Caledonia.

28 March 2002: We had a day-trip by plane to the Isle of Pines. The island is mainly of ancient raised coral, but with a central elevated ultrabasic rock interior. Much of the forest has been heavily exploited, the main local hardwood timber trees being kohu (*Intsia bijuga*) and buni (*Manilkara dissecta*). Sandalwood (*Santalum austrocaledonicum*) was once heavily exploited. The calcareous substrate (as in the Loyalty Islands) supports a quite different flora to that of the ultrabasic and schist substrates of the Grand Terre. Apart from *Cycas seemannii* and *Araucaria columnaris*, gymnosperms are absent, and there are no Cunoniaceae, Ericaceae or *Gymnostoma*, and fewer Araliaceae, Cyperaceae and Myrtaceae. Common genera include *Diospyros, Eugenia, Austromyrtus, Cupaniopsis*, and *Arytera* (Lowry 1996). Bois tabou (*Fagraea berteroana*) and raporé (*Mimusops elengi*) are fairly common trees.

The buni tree is large and handsome, with a spreading crown. We saw buni timber, which is hard and yellowish, being used for cross members in dug out canoes. Historic sites are traditionally marked with a totem fence of kohu stems, sometimes carved. The wood is exceedingly durable.

Pin colonnaire (*Araucaria columnaris*) is the main dendrological icon of the Isle of Pines, and occurs commonly right on the coast in groves. Some are 45 m tall. The timber is used locally for general carpentry, and particularly for dug-out canoes.

A feature of the Isle of Pines is the rampant growth of weed trees on roadsides and in thickets, the principal species being *Schinus terebinthifolius*, thorny poinciana (*Caesalpinia sepiaria*), *Leucaena leucocephala, Lantana camara, Psidium guajava*, Mauritius hemp (*Furcraea foetida*), and *Melia azedarach*. *Pinus caribaea* and *P. elliottii* occur in extensive plantations, and niaouli *(Melaleuca quinquenervia*), as on Grande Terre, is widespread.

Coastal plants abound, and some of the species identified were noni (*Morinda citrifolia*), *Calophyllum inophyllum*, coconut (*Cocos nucifera*), *Scaevola sericea, Excoecaria agallocha*, Chinese lantern tree (*Hernandia nymphaeifolia*), *Acacia simplex, Erythrina variegata* (an impressive shade tree), *Argusia argentea, Sophora tomentosa, Myoporum tenuifolium, Pemphis acidula* (Lythraceae), *Suriana maritima* (Surianaceae), curtain fig (*Ficus microcarpa* var. *hillii*), and the mangrove *Bruguiera gymnorhiza* with its characteristic knee-like roots. Altogether there are 12 species of mangrove in New Caledonia, comprising *Rhizophora* (5 spp.), *Bruguiera* (1 sp.), *Lumnitzera* (2 spp.), *Sonneratia* (1 sp.), *Avicennia* (1 sp.), *Xylocarpus granatum*, and *Heritiera littoralis* (Mueller-Dumbois & Fosberg 1998). At Vao at the site of the historic Catholic church we found a tree of otaheite apple (*Spondias cythera*) – an edible fruit related to the mango, and several fine specimens of hoop pine (*Araucaria cunninghamii*).

An interesting local snail is *Placostylus fibratus*. It is edible and harvested from the bush by the local people for sale to restaurants in Nouméa. This genus also occurs in New Zealand. The common introduced giant African snail (*Achatina fulica*), however, which we frequently saw on the Grande Terre, is not edible, and in fact is a serious plant pest.

Our tour of the island took in the main settlement, Vao, with its lovely old church, the Baie des Pirogues where some canoes were under construction by the local people, Le Meridien hotel at Oro, and Kuto. We had a wonderful buffet lunch at Petersen's restaurant beside Kuto Beach, after which people variously rested, swam with fish at Kuto Beach, or snorkelled and beach-combed at Baie de Kanumera.

After lunch Rosemary and Graeme Platt walked past the ruins of the prison - a legacy from the penal settlement period - towards the jetty at Kuto Bay. In the distance the tops of a grove of *Araucaria columnaris*, towering over the canopy of a broad-leaved coastal forest in the foreground, could be seen, and invited closer inspection. The walk along the raised and undermined coral coastal shelf to the end of the peninsula proved to be one of the highlights of the visit to the Isle of Pines. The seaward end of the peninsula was populated with the most spectacular grove of *Araucaria columnaris* that we were to visit. The raised coral shelf was lined to its overhanging lip with a dense belt of *Araucaria columnaris* - no more than 80 metres deep, running parallel to the foreshore. As is typical with this species, each tree had a gently sweeping "S" bend in its trunk as it reached skyward. Two or three sea-birds flew in circles through the dense stands of towering *Araucaria columnaris*, squawking out a protest at the human intrusion into this special place. At a number of locations under the shade of the tall trees on the weathered coral, thousands of *Araucaria* seedlings - many up to half a metre high - were battling each other for a place in the sun. A few scattered *Pandanus tectorius* and bushy *Myoporum* shared the bony coral foreshore. The tropical sun lowered quickly towards the western horizon as we headed back on the track to Kuto beach, and the return flight to Nouméa.

29 March 2002: *Amborella trichopoda* has survived for at least 130 million years and it is generally acknowledged to be the oldest angiosperm on earth—the most primitive flowering plant alive today. It occurs on the Plateau de Dogny, Sarraméa. David de Laubenfels, Ruth Stockey, Mike Wilcox, Sean Graham,

Margaret Barker, and Wyne Johns visited Mme Suzanne and M. Gérald Moglia, Sarraméa at Col d'Amieu, where we saw *Amborella trichopoda* growing in the forest. It is locally fairly common in this district, and is a somewhat sprawling shrub or small tree in the understorey of tall mixed rain forest on a schist substrate. *Amborella*, a monotypic, dioecious, vessel-less dioecious shrub from New Caledonia, has been recognised as the first branch of angiosperm evolution ("the sister to all other extant angiosperms"), followed by the Nymphaeales (water lilies), and then Illiciaceae, Schisandraceae and Austrobaileyaceae.

The Moglia's garden is full of cultivated fruit trees and ornamentals, some of those noted being Chinese fir (*Cunninghamia lanceolata*), bunya (*Araucaria bidwillii*), ylang ylang (*Cananga odorata* :Annonaceae), macadamia nut (*Macadamia integrifolia*), pomegranate (*Punica granatum*), grape (*Vitis vinifera*), olive (*Olea oleifera*), avocado (*Persea americana*), various citrus fruits, and, surprisingly, peaches and pears.

The forest at Col d'Amieu has a gigantic houp tree (*Montrouziera cauliflora*), 7.5 metres in circumference, and plentiful *Elaeocarpus angustifolius*- a successional tree. Another big tree found in this forest is tamanu (*Calophyllum caledonicum)*. The large proteaceous trees hêtre rouge (*Sleumerodendron austro-caledonicum*) and hêtre (*Kermadecia sinuata*) occur in the vicinity. The tree ferns *Cyathea intermedia* and *C. novaecaledoniae* are particularly large in this area, and there is also an abundance of elephant fern (*Angiopteris evecta*) and *Marattia attenuata*. The large moss *Spiridens vieillardii* (Spiridentaceae) grows on the trunks of tree ferns. The fern *Histiopteris incisa*, which also occurs in New Zealand and Australia, is common on disturbed forest margins, together with the edible Asian thimbleberry (*Rubus rosifolius*), the prickly solanum (*Solanum torvum*), both introduced plants, and *Trema cannabina*.

Araucaria humboldtensis has its habitat high on the flanks of the summit slopes of the Massif du Humboldt. With an altitude of 1618 metres, Mont Humboldt is the second highest mountain in New Caledonia. Mont Humboldt is located twenty minutes' flying time by helicopter, north/north-west of Nouméa's Magenta Airport.

Derek Spicer, Lachie Andrews, and Rosemary and Graeme Platt chartered one of these machines to facilitate a visit to the *Araucaria humboldtensis* trees. Except for the fertile valley floors leading into Nouméa with their orchards, the ranges of hills we flew over were clothed in the typical sparse open low maquis vegetation. As we approached Mont Humboldt, a large cloud-bank to the north was spilling over the summit ridge, down through the steeply sloping *Araucaria*-dominated forests. The very distinctive flat-topped *Araucaria humboldtensis* trees at first looked like groves of tree ferns with tall clean trunks in the distant mist. As the mist came and went, we were able to fly back and forth along the southern slopes of the summit peak, photographing the trees. The wet cloud forest of mixed tree species was dominated by emergent *Araucaria* trees.

A hut could be seen on a saddle a few hundred metres below the summit peak. The ever-threatening cloud-bank precluded any possibility of landing on the mountain to allow a ground inspection of the *Araucaria* trees and their companions. Returning in the direction of Nouméa, the pilot landed the helicopter on a lower ridge, at approximately 800 metres in altitude, near a grove of sparsely scattered *Araucaria rulei*, with their distinctive white trunks gleaming in the sunlight. The maquis vegetation surrounding the *Araucaria rulei* was lower and more sparse than normal on the ironised mineral-rich ridge. While *A. rulei* is, for the most part, a lean nutrient-deprived tree, this grove contained a couple of magnificent specimens - by far the best we were to see. A few large old distinctive male pollen cones lay spent on the ground under the trees. After a total of forty-five minutes' flying time, we were back on the ground at Magenta Airport, highly stimulated by another great adventure amongst the *Araucaria* trees.

In the evening, Thierry Azaïs presented each member of a group with a poster and booklet, specially put together for us.

30 March 2002: Prominent planted shade trees and ornamentals in Noumea are rain tree (*Samanea saman*), royal poinciana (*Delonix regia*), pink or appleblossom shower (*Cassia javanica*), African mahogany or acajou cailcedrat (*Khaya senegalensis*), umbrella tree (*Schefflera actinophylla*), African tulip tree (*Spathodea campanulata*), Cuban pink trumpet tree (*Tabebuia pallida*) and perhaps also lapacho (*Tabebuia impetiginosa*), tamarind (*Tamarindus indica*), mango (*Mangifera indica*), sea almond (*Terminalia catappa*), silky oak (*Grevillea robusta*), salt cedar or tamarisk (*Tamarix aphylla*), pride of Barbados (*Caesalpinia pulcherrima*), fish-poison tree (*Barringtonia asiatica*), banyan (*Ficus prolixa*), frangipani (*Plumeria acutifolia*), red frangipani (*Plumeria rubra*), pin colonnaire (*Araucaria columnaris*), royal palm (*Roystonea regia*), date palm (*Phoenix dactylifera*), queen palm (*Syagrus romanzoffianum),* fishtail palm (*Caryota mitis* and *C. urens*), petticoat palm (*Washingtonia robusta, W. filifera*), coconut palm (*Cocos nucifera*), Manila palm (*Veitchia merrillii*), Pacific palm (*Pritchardia pacifica),* golden cane palm (*Chrysalidocarpus lutescens*), and some eucalypts (*Eucalyptus deglupta, E. camaldulensis, Corymbia citriodora*). A curious, fastigiate form of *Erythrina variegata* known as *Erythrina variegata* var. *fastigiata* is commonly encountered near towns,

On the way to the Tantouta Airport we visited a commercial ornamental nursery, Pacifique Jardin, operated by M. Ramieu and Catherine Jarossay. Trees growing wild beside the road leading to the nursery were niaouli (*Melaleuca quinquenervia*), bois de fer (*Casuarina collina*), and Java plum (*Syzygium cuminii*) – this latter an introduced tree with an edible fruit.

They are propagating a wide range of tropical herbs, shrubs, palms, and trees for the local market. The main trees grown are pin colonnaire (*Araucaria columnaris*), kaori (*Agathis lanceolata*), narrow-leaved mahogany (*Swietenia mahagoni*), and various tropical flowering trees - rain tree (*Samanea saman*), flamboyant (*Delonix regia*), *Cerbera odollam*, golden shower (*Cassia fistula*), pink shower (*Cassia javanica*), Cuban pink trumpet tree *(Tabebuia pallida),* Moluccan sau (*Paraserianthes falcataria*), jacaranda (*Jacaranda mimosifolia*), yellow poinciana (*Peltophorum pterocarpum*), siris tree (*Albizia lebbeck*), fish-poison tree (*Barringtonia asiatica*), crepe myrtle (*Lagerstroemia indica*), flame tree (*Brachychiton acerifolius*), *Terminalia mantaly* (from Madagascar), and orchid tree (*Bauhinia purpurea*) and others such as *B. monandra*, *B. tomentosa* and *B. variegata*.

Popular shrubs and climbers are coral vine (*Antigonum leptopus*), pride of Barbados (*Caesalpinia pulcherrima*), tiare (*Gardenia taitensis*), orange jessamine (*Murraya paniculata*), yellow trumpet flower (*Allamanda cathartica*), bougainvillea (*Bougainvillea spectabilis*), and Brazilian flame creeper *(Pyrostegia venusta*).

The nursery has an impressive collection – reputedly the world's biggest, with some 400 cultivars – of croton (*Codiaeum variegatum*). This is a very common ornamental shrub cultivated in the tropics. The leaves are colourfully variegated red, green, and yellow, and also vary greatly in size and shape.

Summary and evaluation

This tour was hugely successful in familiarising ourselves with the indigenous New Caledonian flora and vegetation, and with the ecology and distribution of the Araucariaceae. For the dendrologist and general botanical traveller, several features stood out.

- The wealth of exotic tropical shade and flowering trees and palms in the towns, such as *Delonix regia, Cassia javanica, Samanea saman*, and the splendid *Khaya senegalensis* – a common avenue tree in Nouméa.
- The widespread tropical Pacific trees and shrubs of the coastal strands, such as *Acacia simplex*, *Casuarina equisetifolia*, and *Hibiscus tiliaceus*.
- The weedy thicket-forming introduced shrubs of roadsides and disturbed forest margins, such as *Leucaena leucocephala*, *Schinus terebinthifolia* and *Melia azedarach*.
- The Australian look to the vegetation on the drier, western side, such as *Acacia spirorbis, Melaleuca quinquenervia* and *Casuarina collina*.
- Except for some areas of cattle ranching, the general lack of cultivated land.
- The scarring of the land through nickel mining.
- The great importance of certain families such as the Casuarinaceae (Jaffré *et al.* 1994), Apocynaceae, Myrtaceae and Cunoniaceae in the maquis and moist evergreen forest vegetation on ultrabasic soils.
- The curious candelabra-like habit of many trees e. g. *Cerberiopsis*, *Gymnostoma*, and many *Araucaria* (Veillon 1978, 1980).
- The prevalence of bullate (bubbly, blistered surface) leaves in many unrelated genera, e. g. *Cunonia bullata* (Cunoniaceae), *Eugenia bullata* (Myrtaceae), *Nothofagus codonandra* (Nothofagaceae), *Elaeocarpus bullatus* (Elaeocarpaceae), and *Sloanea koghiensis* (Elaeocarpaceae).
- The wealth of native conifers, most of which have a restricted distribution, and with the exception of *Araucaria*, are generally scattered or mixed with broadleaved species (de Laubenfels 1972; Farjon 1995; Jaffré 1995; McInnes-King 2000).
- Evolutionary significant plants, such as *Arillastrum gummiferum*, considered to have affinities with *Eucalyptus*; *Joinvillea plicata*, the mostly closely related living monocot to the grasses; and *Amborella trichopoda*, perhaps the most primitive of all woody dicotyledons.
- The almost complete absence of native herbaceous plants.
- The abundance of the Cyperaceae in the maquis vegetation.
- The critical importance of geology in shaping the vegetation and distribution of species.
- The abundance of pteridophytes, and with some 31 species of ferns and fern allies being identical to those found in New Zealand.

Each day had its dramatic moments as new sites were visited, and new species seen. Highlights were many, and particular ones that will remain in the memory for a long time were our first meetings with *Araucaria rulei* in the north and *A. muelleri* in the south; the impressive stands of *A. columnaris* on the Isle of Pines; the strange furrow-barked, flat-topped *Agathis ovata*; the most curious of all conifers – the parasitic *Parasitaxus usta* and the rheophytic *Retrophyllum minus;* some gigantic individual trees of *Agathis lanceolata* and *Montrouziera cauliflora;* the spectacular buttresses of *Sloanea koghiensis*; the great variety of beautiful maquis shrubs of genera such as *Xanthostemon* and *Cunonia;* and for those fortunate to see it, *Amborella trichopoda* – an unassuming forest shrub that was sensationally revealed to the botanical world at the XVIth International Botanical Congress in 1999 at St Louis, Missouri, USA as sthe most primitive of all living woody flowering plants (Barkman *et al.* 2000; Parkinson *et al.* 1999; Qiu *et al.* 1999).

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Nomenclature

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Annex 1
Casuarinaceae in New Caledonia

Casuarina equisetifolia L. Johnson subsp. *incana* (Benth.) L. Johnson
Abundant on beaches. Widespread in the Pacific, but not considered indigenous to New Caledonia.

Casuarina collina Poiss. ex Panch. & Sieb.
bois de fer, ironwood. Common throughout, especially in tall riparian communities. Also common on the dry west coast side in secondary forests.

Gymnostoma chamaecyparis (Poiss.) L. Johnson
wayu. Poor ultramafic soils. Shrub maquis. Occurs on drier steep slopes of the ultramafic massifs. Associated with hypermagnesian soils below 600 m elevation, at the base of ultramafic massifs.

Gymnostoma deplancheanum (Miq.) L. Johnson
On ultramafic terrain, with high levels of Ni, Mg, Mn, Cr, Fe, and Mn, on ferralitic ironstone and gravelly soils. Higher rainfall sites of southern Grande Terre, at 200-1000 m elevation.

Gymnostoma glaucescens (Schlechter) L. Johnson
Occurs in forest Up to 15-20 m tall. On alluvial soils.

Gymnostoma intermedium (Poiss.) L. Johnson
Occurs in forests. Up to 15-20 m tall. Ultramafic soils. In montane ultramafic vegetation. Mainly 700-1000 m elevation on eroded slopes, and ferralitic gravelly soils.

Gymnostoma leucodon (Poiss.) L. Johnson
Riparian sites. Restricted to the Southern Massif.

Gymnostoma nodiflorum (Thunb.) L. Johnson
It occurs on non-ultrabasic substrates, usually alluvial soils of volcano-sedimentary origin. Mainly in the northern half of the Grande Terre.

Gymnostoma poissonianum (Schlechter) L. Johnson
Occurs in forests, up to 15-20 m tall. Secondary rain forests, 200-700 m, on eroded slopes.

Gymnostoma webbianum (Miq.) L. Johnson
Mainly in the northern half of the Grande Terre.

Annex 2
Araucariaceae in New Caledonia

Agathis corbassonii de Laub.
Corbasson's kaori, kaori rouge. N Grande Terre. Tree to 40 m. Scattered in areas of lowland moist forest, 300-700 m, on non-ultramafic substrates. It is exploited for its timber, most heavily at a local level.

Agathis lanceolata (Sebert & Pancher) Warb.
kaori de forêt Type near Mont Koghi, at 200-1100 m elevation. Typically growing as an emergent in subtropical rain forest on ultramafic soils in the southern parts of the island. Large timber tree to 40 m and 2. 5 m diameter. The tallest of the genus in New Caledonia. Good stands in the Ni Valley north of Noumea.

Agathis montana de Laub.
Mont Panié kaori. Mont Panié, Mont Colnett, Mont Ignambi, NE Grande Terre. Tree 15-20 m, with a large, flattened crown. 1000-1600 m altitude. Forms monospecific stands in summit forests. Not found on ultramafic rocks.

Agathis moorei (Lindley) Masters
kaori blanc, Moore kaori. Pembe to Thio and Dumbea to Prony at elevations of 200-1000 m. Tree to 25 m tall. Elevations of mostly 300-600m, but up to 1000 m. On soils from metamorphic rocks, including shales, sandstones, and schists. Lowland rain forest.

Agathis ovata (C. Moore) Warburg
scrub kaori dwarf, kaori de montagne. S Grande Terre: Mont Humboldt to Montagne des Sources, 150-1000 m. Grows in small stands, generally very open, or sometimes in forest. On ultrabasic laterite carapace in fire-swept maquis vegetation on arid exposed ridges. Usually solitary. Shrub from 1-8 m tall or tree to 25 m.

Araucaria bernieri Buchholz
Bernier's araucaria. Poum, and from Canala to Plaine des Lacs, 100-700 m. To 50 m. Generally occupies steep slopes and debris slips in deep valleys and gullies. Good forests of this species occur on ultramafic rocks at the Rivière Bleue Park. Also Mont Dzumac. A columnar tree emergent above rain forest. Often associated with *Agathis lanceolata*.

Araucaria biramulata Buchholz
biramule araucaria. Western side of Grande Terre. Type from Mois de Mai, 300-1050 m. Mont Kaala, 1000 m. Mont Do. Col d'Amieu. A columnar tree to 30 m. tall, with numerous, spreading branches

Araucaria columnaris (J. R. Forst.) Hook.
Cook pine, pin colonnaire. Isle of Pines, Loyalty Islands, Grande Terre. Maximum growth and abundance at the edge of the sea, in dense evergreen forest on ancient raised coral reefs. Commonly planted all over New Caledonia, and grown in the tropics as an ornamental. Grows to 60 m and 1.5 m diameter on the Isle of Pines, forming dense pure stands of striking columnar habit, standing above stunted forest on cliffs, exposed the prevailing winds. These populations, which mostly form narrow strips of a few dozen metres wide, are among the most spectacular plant formations of New Caledonia. "La marque déposée de la Nouvelle-Calédonie".

Araucaria humboldtensis Buchholz
Humboldt araucaria. Mont Humboldt, Mont Mou and Montagne des Sources, 750-1500 m. Occurs on the southern portion of the island, on ultramafic substrates. A tree 6-15 m tall, with a steep branches forming a flattened, candelabra-like crown.

Araucaria laubenfelsii Corbasson
de Laubenfels araucaria. At 400-1300 m, southern mountains around Nouméa: Mont Mou, Montagne des Sources, Mont Dzumac, Mont Do. At Mont Do Botanical Reserve, this species receives an average rainfall of 1690 mm per year (more if fog drip is accounted for), with a precipitation maximum in February (avg. 255 mm) and minimum in September (45 mm). It occurs on ultramafic soils in both maquis and as an emergent in upland rain forest. In both habitats is evidently regenerates more or less continuously in response to small-scale disturbances including fire (in maquis) and blowdown (in maquis and rain forest). It does not form closed stands. On Mont Do massif, on ultramafic soils as an emergent tree in rain forest and also in maquis vegetation. A columnar tree 10-50 m

Araucaria luxurians (Brongn. & Gris) de Laub.
coast araucaria. S Grande Terre: along the coast, 0-200 m. Local in maquis and forests. Sensitive to fire. Able to grow on brown hypermagnesian soils, with very high Mg and low Ca levels. A columnar tree to 30 m tall.

Araucaria montana Brongn. & Gris
mountain araucaria. Throughout the Grande Terre on crests of mountain ridges, and plateaux, often visible from a great distance. 300-1300 m. Columnar tree 10-40 m tall. Branches numerous and spreading.

Araucaria muelleri (Carrière) Brongn. & Gris
Mueller araucaria, pin candélabre. S Grande Terre: Mont Koghi to Montagne des Sources, 150-1000m. A tree 10-25 m. tall, with a candelabra-like crown, but trees on ironstone substrate on the Goro Plateau are stunted..

Araucaria nemorosa de Laub.
Boisé araucaria. Southern Grande Terre: Port-Boisé, to 10 m altitude. Known only from a six small stands near the coast, Bay of Port-Boisé, in the extreme south. Emergent in rain forest. A tree to 15 m tall, with an oval or conical crown. On serpentine.

Araucaria rulei F. Muell.
Rule araucaria. Central and southern Grande Terre, 150-1200 m. On serpentine soils. Generally occupies sites containing nickel ore. A tree to 30 m tall but usually much smaller, with an open crown of candelabra branching.

Araucaria schmidii de Laub.
Schmid araucaria. NE Grande Terre: Mont Panié, rare, 1500-1630 m. Only found as an emergent above low forest on the escarpment slopes bordering on the summit plateau of the Mont Panié Range. Not found on ultramafic rocks. A tree to 30 m tall, with numerous ascending branches.

Araucaria scopulorum de Laub.
Rock araucaria. NE Grande Terre: Poum, Dothio, Cap Bocage, Houailou, 0-200 m. Small tree 5-20 m, with an oval crown. On rocky serpentine sites.

Araucaria subulata Vieillard
Narrow-leaf araucaria. S Grande Terre: Ignambi; Canala; Mont Dzumac; Montagne des Sources, 320-1900 m. A straight columnar tree to 50 m tall. Ultramafic soils.

Acacia parramattensis in Northland

Mike Wilcox

When travelling in Northland this January I noticed in several places groups of a large species of bipinnate wattle in flower. Familiar wattles such as silver wattle (*A. dealbata*), green wattle (*Acacia decurrens*), and black wattle (*A. mearnsii*) flower from winter to late spring (July-October), so it was not one of these. Likewise, cedar wattle (*A. elata*) was ruled out because it is a larger tree and has very much bigger pinnules, and flowers mainly February to March.

Close examination of the summer-flowering Northland trees showed them to be Parramatta wattle (*A. parramattensis*), a species from the Blue Mts and the Penrith-Wiseman's Ferry area of New South Wales, Australia. I recorded trees at Rainbow Falls (Kerikeri) and beside the road from Kerikeri to Waimate North. The Rainbow Falls trees appear to be thoroughly wild, and were at least 10 m tall.

Parramatta wattle looks rather like black wattle, with the flowers the same pale yellow, but I noticed it lacked the disfiguring galls caused by *Uromycladium* rust so common on older trees of black wattle. The herbarium at the Auckland Museum has records of *A. parramattensis* from Rawene, Haruru Falls (Waitangi), Kerikeri Falls, and Brodie's Inlet (Rangaunu Peninsula).