Field Observations on Rhododendrons in New Guinea

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For the last 22 years I have been collecting field observations on the conditions under which rhododendrons grow in New Guinea. This paper outlines the growth factors involved. As these are field observations only, all factors must be evaluated carefully with regard to local growth conditions, when growing these rhododendrons in cultivation.

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New Guinea is the second largest island in the world, situated north of the Cape York peninsula of Queensland, Australia. It is some 1000 miles long by about 500 miles wide at the widest point. The island has a backbone of several parallel ranges of mountains reaching 16,000 feet in the Pyramid in the Carstensz Mountains of West New Guinea. Outside these central ranges we find several ranges of lower mountains, although Mount Bangeta in the Sarawaket Mountains reaches 14,000 feet. In between these lower ranges and the central backbone we find extensive swampy regions, the largest of which are the Mamberamo River, Sepik River, Fly River, and Digoel River areas.

The climate of New Guinea is very varied. It ranges from humid tropical with no discernible seasons and a rainfall as high as 350 inches, to seasonally dry and a rainfall of about 50 inches in the dry savannahs. Temperatures range from 93°F in the lowlands to permanent frost in the glaciers of West New Guinea.

Rhododendrons are found in all areas except the dry savannahs of the south, from sea level to the snowline. Those that have been introduced to

horticulture are found mainly between 2500 feet and 12,000 feet although *Rhododendron saxifragoides* and *R.rubellum* reach 14,000 feet. Although in general no rhododendrons are found in the steamy lowland forests, I have found *Rhododendron zoelleri* on a slope about 3 feet above sea level, regularly sprayed by seawater. This species grows in a wide variety of habitats and may be composed of several ecotypes.

The scientific grouping of the genus *Rhododendron* has been worked out by Dr. Hermann Sleumer among others. I had the good fortune to have Dr. Sleumer on my team during the 2nd New Guinea Expedition of the National Herbarium of the Netherlands at Leiden. Sleumer had his manuscript of the future publication in the Flora Malesiana with him, and was thus able to check it against living material. I did not agree with him in several cases but nevertheless the paper was published with little change. Sleumer frequently had to base his decisions on a single specimen. It is therefore not surprising that since 1966 when Paul Kores and I had a chance to see more material, some changes had to be made in Sleumer's system. You will find these changes in the third volume of my Alpine Flora of New Guinea, published in 1982.

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Rhododendron hellwigii Warburg, Mt. Bangeta, 3000m
(Photo: P.Kores)

In New Guinea 160 species of *Rhododendron* are known, most of them terrestrial. They all belong to the subgenus *Rhododendron*, and all are in the

section Vireya of that subgenus, the only section found in the Malesian area. Sleumer divides the section Vireya into 8 subsections of which only the subsection Malayovireya is not represented in New Guinea. The most attractive *Rhododendron* species are found in the subsection Phaeovireya for example, *Rhododendron hellwigii, R.superbum,* and *R.beyerinckianum*. Some species have strongly fragrant flowers, among them *Rhododendron dianthosmum* with a strong scent of pinks (*Dianthus*) or *R.hyacinthosmum* with a strong scent of hyacinths. The earlier mentioned *R.superbum*, and its close relative *R.hellwigii*, both have strong vanilla-like scented flowers. Both grow on the ground or as epiphytes, hybridize easily, and are potentially the best New Guinea rhododendrons for horticulture. Cuttings were brought back to Paul Kores' nursery in Wau when he was assigned there by the Stanley Smith Horticultural Trust. Sleumer's subdivision works reasonably well, although we have come across some species that could equally well be placed in different sections. With their strong tendency to hybridize, this sort of breakdown in the classification can be expected and does not detract from Sleumer's truly magnificent studies.

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Rhododendron superbum Sleumer, Mt Giluwe 2800m
(Photo: B.Gagne)

The flowers of the New Guinea rhododendrons are of a different shape from the ones that we know of from, for instance, the Himalayan species. They are predominantly tubular, whereas the Himalayan ones are more bell-shaped. They range in size from under 1 inch in *Rhododendron lindaueanum* to well

over 8 inches in *Rhododendron leucogigas*, which at the same time has the advantage of being strongly carnation scented.

The number of New Guinea species in cultivation is about 60. With 160 species known there is still more room for further introductions. The most common species in cultivation are *Rhododendron aurigeranum* and *R.zoelleri*, two very closely related species, and *R.konori, R.laetum,* and *R.macgregoriae*. With the last as a parent several hybrids have already been produced. However, these are not comparable as yet to hybrids of this species found in the wilds. The colour variation of *R.macgregoriae* - pale yellow through orange to deep salmon red - make this species even more worthwhile for horticulture purposes. Here too, as in *R.zoelleri*, we have to realize that several ecotypes exist. On our trip to the Victor Emanuel Mountains we found a hybrid of *R.macgregoriae* and *R.rubrobracteum*. This hybrid produced a cascade of magnificent flowers. Both parents have short tubular flowers, but the hybrid had longer tubular flowers and a colour range from a pale pink tube with yellow lobes to deep pink tubes with peach coloured lobes. They had no fragrance, and attempts to raise cuttings of this beauty in Wau failed. It is worthwhile to try to bring back some of these natural hybrids, if only because they are superior to hybrids raised in this country. It will be particularly useful to watch the F2 generation of these hybrids. This applies also to the F2 generation of locally grown hybrids. Some of these have already flowered and have produced gorgeous flowers. With an influx of natural hybrids we may develop some beauties.

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Our main problem in introducing New Guinea rhododendrons into cultivation is just this fierce hybridization that is going on in the field. Bringing seeds back from a seemingly good species does not always guarantee that the results will truly reflect the parent. There is a classic example of a grower in Australia (Withers in Adelaide), who received seeds of *Rhododendron saxifragoides*, sowed them out and raised some plants. *R.saxifragoides* is a cushion-like species with solitary flowers (rarely 2) on a stalk at the utmost 6 or 7 inches long. One of his plants, however, developed into a small shrub about 2 feet

high with flowers like those of *R.commonae*, in trusses of two or three. *R.commonae* is often found in the same areas as *R.saxifragoides*.

Rhododendron rubrobracteum Sleumer
Mt. Womtakin 2900m
(Photo: P.Kores)

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The conditions under which rhododendrons grow in New Guinea are various and variable. The main controlling factor seems to be temperature. The genus as a whole does not seem to be limited by temperature, but many species exhibit optimum growth over narrow temperature ranges. The species exhibiting the widest temperature tolerance is the common *Rhododendron zoelleri*, which is found from sea level with temperatures of 90°F to about 6,000 feet with temperatures of 60-70°F. These are daytime maximum temperatures. Night temperatures at the altitudes mentioned are about 85°F and 55°F respectively. For the equally common *R.macgregoriae*, the temperature range is from about 80°F at about 2,000 feet to 40-50°F at about 10,000 feet.

The main temperature belt where most New Guinea species are found is that between 60-75°F at altitudes of 3,000 to 4,000 feet and 55-65°F at 9,000 to 10,000 feet. In the lower levels the lowest temperatures do not appear

important, but at the 10,000 feet level night temperatures drop to about 40°F. In this belt we find such species as *Rhododendron aurigeranum, R.dianthosmum, R.hellwigii, R.herzogii, R.laetum,* and *R.superbum*. In this belt some species are restricted to narrow altitudinal limits. *R.phaeochitum*, for example, is found only between 6,000 and 9,000 feet, *R.pleianthum* only between 8,500 and 10,500 feet, and *R.superbum* only between 9,000 and 10,000 feet, although the last is occasionally found as low as 7,000 feet. But here we have a problem with the area under consideration. *R.herzogii* is usually found at about 6,000 feet on Mt Womtakin, but around 8,000 feet in the Finisterre Mts, while *R.superbum* is found at about 10,000 feet on Mount Giluwe and around 5,500 feet on Mt Womtakin. This difference can be explained by the local climate and topography. Mt Giluwe is an isolated massive old shield volcano, under the influence of the drier southeast trade winds most of the time, whilst Mount Womtakin is in the central ranges and mostly under the influence of the wetter northeast trade winds. It is clear therefore that temperature alone is not the deciding factor.

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In the alpine regions where the average day temperature ranges from 33-40°F and almost every night drops below freezing, we find few *Rhododendron* species. The highest occurring species are *R.rubellum* and *R.saxifragoides*. Both are found as low as 10,000 feet but reach their best development between 12,000 and 14,000 feet. Both species are found in an area where the sun bakes the grasslands for most of the year, particularly from May to September, while for the rest of the year heavy rainfall, mists, hail, and occasionally snow dominate the grasslands.

A second factor that, however, in the case of rhododendrons does not seem to be too important, is relative humidity. There is an overall decrease in relative humidity between the constant high humidity values of the lowlands and the fluctuating humidity values of the alpine zone.

Rhododendron comptum Wright, var.*trichodes* Sleumer
Mt. Albert Edward 3800m
(Photo: P.van Royen)

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It is true that *Rhododendron macgregoriae, R.zoelleri* and others are found only in the high humidity belt, and that one finds *R.commonae* mainly in the subalpine belt, whilst *R.saxifragoides* is limited to the alpine belt. But stating this, one overlooks the fact that most species are found in open places, often where the original vegetation has been destroyed and where rhododendrons are often among the first to appear as colonists. Other species are found growing as epiphytes in the crowns of trees, and those ecological niches are not very wet. Rather, they represent at times extremely dry habitats. Therefore *R.superbum*, although found in the upper montane zone where the humidity is seemingly always close to 100%, is also found growing as an epiphyte in trees where the relative humidity is closer to 40 to 50%. Under horticultural conditions this species, when grown as a terrestrial, can do with less water than other species such as *R.beyerinckianum*. This is another species of the montane area, usually found as a terrestrial or as an epiphyte on the trunks of trees where the humidity is higher than in the crowns. The leaves of *R.superbum* are considerably thicker than those of *R.beyerinckianum*, pointing to the ability of the former to grow under drier conditions than the latter.

Another factor that might be important in growing the New Guinea rhododendrons is light, or rather its composition and intensity. The species growing from sea level to the upper montane level are subjected to light of the normal spectrum from infrared to ultraviolet, with the usual variation in intensity. So, when a species is growing along the shrubberies' edges it receives more light than when growing as an epiphyte under the foliage of trees. I have observed only in *Rhododendron macgregoriae* and *R.zoelleri* that there is a difference correlated with habitat in the number of flowers in the truss and in the size of the flowers. In open sunny places the flowers are larger and there are more of them in each truss. There also seems to be a variation in colour between the flowers of sunny versus shady areas. Those in the sun seem to be more reddish, those in more shady areas, more yellow. This is explainable as under the influence of light more anthocyanins, which are usually red, tend to be developed than under shady conditions. This may also explain why the *Rhododendron* species at higher altitudes all tend to have red flowers, while those of lower altitudes tend to be more white, yellow, or orange. At higher altitudes, however, another factor becomes important, a factor that in New Guinea has not been studied but seems obvious. At higher altitudes less ultraviolet radiation is filtered out. The influence of higher and lower humidity may be another factor, as the higher the humidity the more ultraviolet rays tend to be filtered out of the spectrum. Therefore specimens of *Rhododendron commonae* growing in the alpine grasslands tend to have smaller, thicker leaves, with more flowers in each truss, and flowers of a deeper red than is true of the species when growing in the shade of the subalpine shrubberies. Although these differences may be due to a combination of differences in light intensity within the visible wavelength spectrum and humidity, ultraviolet radiation may well also play a role. Little is known about the interaction of these factors and it may be worth experimenting on the effect of ultraviolet light on the growth of rhododendrons. The composition of the air and air pressure are factors about which nothing is known as to their influence on the growth of rhododendrons, if any.

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Rhododendron leptanthum Sleumer
Mt. Kaindi 2800m
(Photo: P.Kores)

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A final, but most important factor is the soil in the rhododendron habitats in New Guinea. To begin with we must distinguish the soils in which epiphytes grow from soils in which terrestrial species are found.

The soil in which epiphytes grow is sparse and is composed mainly of bark particles and other decomposing vegetable matter. It is usually highly porous and both dries out quickly and soaks up water quickly. The soil is often black or dark brown, and the root systems of the shrubs growing in it are small but well developed. As a growing medium it is an extreme one. (Not compared to terrestrial plants!) In nature epiphytic rhododendrons are small shrubs, poorly branched, with large and / or thick leaves, and often large, conspicuously coloured flowers. This applies specifically to epiphytes that grow in the tree canopies. The situation is somewhat different for epiphytes that grow lower down on trunks. Often these species grow in moss cushions which maintain higher moisture levels. Their root systems are better developed, but in general the shrubs are small and their leaves are relatively thinner and smaller than

those growing in the canopy. This group of epiphytes is characterized by *Rhododendron beyerinckianum, R.rubineiflorum* and *R.gracilentum*, all with small but beautiful flowers.

The soil conditions in which terrestrial species grow are as varied as are the soils in New Guinea. For example, strongly acid soil based on a loamy subsoil supports virtually no vegetation at higher altitudes, but supports a dense herb, shrub or tree vegetation at lower altitudes, where however the acidity may be somewhat lower. In general the high mountain soils can be grouped according to several altitudinal zones each characterized by specific soils. The soil pattern tends to become more complex at lower altitudes mainly as a result of the more favourable climate interacting with other soil factors.

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At altitudes between 13,000 and 15,000 feet one finds mostly bare rock outcrops, although some vegetation occurs up to at least 14,700 feet. Some of these areas experience occasional short lived snow falls. Somewhat lower, from 12,000 to 13,000 or 14,000 feet, one finds so-called lithosols together with bare rocks. Dwarf shrubs, mosses, lichens and ferns replace grasses as the dominant vegetation. In this zone one rarely finds rhododendrons except in the highest places where alpine heath and alpine humus soils have been formed in wet places. In those places, with a pH as low as 4.5, one finds such beauties as *Rhododendron rubellum* and *R.saxifragoides*. On slightly less acidic and deeper soil one finds such species as *Rhododendron atropurpureum, R.commonae,* and *R.womersleyi*. In the case of *R.saxifragoides* the soil is very wet and most of the time the mats are found in stagnant pools. However, on dry, sunny days these can dry out to some extent. In the case of the last three named species, the soils are fairly wet and have an acidity ranging from 6-7.5. In general the build up of organic matter by the vegetation, which is only slightly mineralized by soil organisms, causes humus and peat accumulation. Crossing this type of area is difficult, in particular in the boggy areas where one sinks down to one's ankle in the black muck. Large tussock grasses usually grow in the area of the three last named species, but in between the tussocks one still finds the black soil. In short the

soil is rather acidic, strongly organic, very porous, but very waterlogged. Combining this soil condition with the low temperatures in that region may explain why *Rhododendron saxifragoides* is so difficult to grow, particularly if one takes into account the diurnal variation of temperatures from 60°F in full sunlight to frost at night over most of the year.

In the zone ranging from 10,500 to 12,000 feet one finds extensive development of the alpine pear and alpine humus soils mentioned above. In contrast with the higher zone, lithosols occur on steeply sloping terrain. In this zone we find, apart from the species already mentioned, such species as *Rhododendron pachycarpon*, a beautiful yellow-flowered species with pendulous flowers. These lithosols are very slippery, light yellowish brown to deep brown in colour, not very porous. When climbing one tends to slide easily down the slopes. This might explain the deep roots of *R.pachycarpon* and other *Rhododendron* species in this habitat.

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In the zone ranging from 9,000 to 11,000 feet one finds the alpine peat and alpine humus soils in combination with rankers or humic brown clays at lower altitudes. On limestone rocks on steeply sloping terrain one finds the rendzinas, but since no *Rhododendron* species grow on the latter soil we can disregard them here. In one way they explain why, in West New Guinea, considerably fewer *Rhododendron* species are found than in the eastern parts of the island. In West New Guinea the high ranges are dominated by limestone cliffs. Rendzinas are soils formed by the breaking down of these cliffs and are highly alkaline. In between the limestone cliffs are extensive acid soil forming rock formations, but these occur to a far lesser extent than in eastern New Guinea.

Rankers are shallow humic brown clays in which weathered rock fragments commonly occur in a yellowish brown subsoil which is overlain by a well developed, black, acidic surface horizon. They are mainly found in the higher altitudes and on steeper sloping areas. A few *Rhododendron* species are

found growing on this type of soil. *Rhododendron beyerinckianum, R.lindaueanum,* and *R.womersleyi* must be mentioned here.

True humic brown clay soils are among the less common soils of the high mountains of New Guinea, and occur mainly between 3,000 and 7,000 feet. They are found on stable, but moderately to steeply sloping terrain, and are characterized by their well developed black to very dark grey brown surface horizon. This horizon overlays a yellowish brown to brown subsoil with a weakly developed blocky structure. However, these soils are not important for our purposes as most of the *Rhododendron* species found in this area are epiphytes.

In general the soils of New Guinea are poor and this might explain why, in horticulture, *Rhododendron* species section Vireya cannot stand fertilization.
Another factor that can be important for those interested in hybridizing the rhododendrons of New Guinea, is the flowering period. Very little is known about the floral ecology of these species. Numerous species occur sympatrically; this is, they are found in the same area, and natural hybrids are known. There is even a possibility a bigeneric hybrids in New Guinea. These hybrids tend to be very rare, but their presence in other parts of the world in this family, demonstrates that some of the closely related genera within the family lack of consistent genetic barriers to hybridization. There is a big field open here for growers to try to grow the New Guinea species of the genus *Dimorphanthera*. Some of the species of that genus, predominantly stragglers, produce masses of rhododendron-like pink or red flowers along 6-8 ft. long branches. If we could cross a climbing *Dimorphanthera* with a shrubby *Rhododendron* we might finally get a 'Vireya Vine', paying thus tribute to Bob Badger's visionary view of a climbing rhododendron.

Paul Kores was the first to point out that interspecific hybridization within the New Guinea *Rhododendron* species can be made impossible by different flowering periods. In most species there is an overlap of flowering periods, such as in the continuously flowering *Rhododendron pleianthum* and

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R.hyacinthosmum. However, this is not always the case, and when no overlap occurs, hybridization will be almost impossible. This is true, for example, with *Rhododendron beyerinckianum* and *R.vitis-idaea*. In the case of species that are already grown in the U.S., it may be found that species with overlapping flowering periods have an even longer overlapping period. But it is a factor that should not be overlooked. The possibility of storing and preserving pollen grains in a pollen bank makes it possible to bridge the gap in flowering periods so as to produce hybrids between species that in nature have widely separated flowering periods.

Another more complicated factor that influences hybridization to some extent is the type of pollinator. there are species pollinated by night hawkmoths (for instance, *Rhododendron pleianthum*, with long tubular flowers), and there are those that are pollinated by birds (*Rhododendron commonae*, with short tubular flowers). In cultivation we can always get around that problem by the use of a fine brush.

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Another factor that prevents hybridization in nature is unimportant for rhododendron growers, and that is geographical isolation. *Rhododendron atropurpureum, R.capellae,* and *R.villosulum* are reported from single mountains only. In culture we can place them together and may derive some beautiful hybrids as a result.

In mentioning these factors one has to take into account that they apply to plants in the field. Under horticultural conditions, all these factors can be varied. For instance, in New Guinea the flowering period of most species falls between March and September, with an occasional flower during the rest of the year. The ones grown in California have their main flowering period in the winter months. This is probably caused by the different length of daylight compared with New Guinea, though other factors may be involved. As yet, we know very little about the interaction of all these growth factors as they relate to rhododendrons.

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