Botanical Study Tour of North East India

November 2017

The "Double Decker" Living Bridge, Meghalaya

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(Merlin 715)

CONTENTS

INTRODUCTION

This report details the highlights and main findings of a study trip to North East India which was made in November 2017. The trip involved travelling through Meghalaya, Assam, Nagaland and Manipur, mainly by road with excursions on foot to explore the local flora.

I work at a National Trust garden in Cornwall (Trelissick near Truro, on the Fal Estuary). Here we are fortunate enough to be able to grow many species of plants which originate in the Sino-Himalayan region, the flora of which extends right down into the parts of North East India which we visited on this expedition. My previous Head Gardener at Trelissick (Tom Clarke, currently Head Gardener at Exbury) has been on two previous expeditions to Arunachal Pradesh in NE India, to study the flora and in particular the rhododendrons found there. Tom's experiences and photographs from these trips really fired my imagination, and we had discussed the possibility of me joining him on his next trip, since we share a strong interest in the flora of India and the Sino-Himalayan region.

Tom Clarke had intended to join John Anderson on this study trip to North East India. In the event, Tom decided that he would not be able to make this trip due to other commitments, but he proposed that I take his place instead. I could hardly refuse such a fantastic opportunity, and so I set about procuring funding to finance the trip. This was relatively late in the day, as it was only a few months before we departed for India, so I am extremely grateful to all four organisations which helped me with the funding (see "Acknowledgements" at the end of this document).

PARTICIPANTS

Richard Holman – I am a professional gardener at Trelissick, on the south coast of Cornwall. I have worked here for the last 5 years. I have always had a strong interest in botany and the natural world, but only became a professional gardener after completing the RHS Level 2 Certificate in Practical Horticulture in 2013. Since that time I have worked at Trelissick; I have not felt the need to move to another garden because of the wide variety of plants that we are able to grow at Trelissick. I am particularly interested in *Rhododendron* species, and also groups such as *Arisaema* and other aroids, *Pleione, Cymbidium, Lilium* and *Nomocharis*, all of which I hoped to see examples of on this trip. I have a strong interest in propagation and one of my main responsibilities at Trelissick is running the nursery and growing plants for the garden. This was my first opportunity to visit India.

John Anderson – Currently Keeper of the Gardens for the Crown Estate (with responsibility for the Savill Garden and Valley Gardens at Windsor Great Park), John was previously Head Gardener at Exbury in Hampshire for several years. John was a student at Kew before working at Mount Usher in Ireland and Inverewe in Scotland. He is a very respected figure in the world of horticulture, who has been a member of the RHS Woody Plants Committee for many years. John is an excellent plantsman with a comprehensive knowledge of plant species, not just woody plants. He has travelled in India on similar plant-hunting expeditions before.

John Sutton – A retired building surveyor based in Hampshire, John Sutton has a keen interest in orchids which was to prove valuable on this trip. He has accompanied John Anderson on previous expeditions to India and other parts of Asia.

The itinerary was organised for us by **Oken Tayeng** of Abor Country Travels and Expeditions, a local company specialising in trekking in Arunachal Pradesh and North East India.

AIMS AND OBJECTIVES

The aims of this trip to North East India were as follows:

1. Meet with Dr Ashiho Mao, Regional Director of the Botanical Survey of India for North East India and also the foremost expert on rhododendrons for the entire area. He is probably the pre-eminent expert on rhododendron conservation in the whole country, and in fact has described a handful of new species in his career. Dr Mao is a self-taught botanist from Arunachal Pradesh, with a wide-ranging knowledge of many other plant groups besides rhododendrons. The intention was to benefit from his local knowledge when trying to locate some of the rhododendron species we were seeking, as well as to build a relationship with him to strengthen international co-operation for the future.

2. A previous expedition to Nagaland had revealed a potential issue with the building of a new forest road on Mount Japfu (the type location for *Rhododendron macabeanum*), which might be opening up the area to greater exploitation in the future. There was a forest fire in this area a few years ago which had decimated the flora, and the fear was that the new road might have compounded this damage or even led to further fires. The intention was to document whether or not the forest was recovering on Mount Japfu, and similarly to document environmental degradation in the other areas we visited.

3. To identify and photograph as many rhododendron species as possible, growing in the wild, to improve my knowledge of their taxonomy, cultivation and propagation. We grow many wild-type species of rhododendrons at Trelissick, in addition to cultivars.

4. Similarly to document the flora of other species in the regions we visited. I have a particular interest in growing *Arisaema* and other aroids, *Pleione*, *Cymbidium*, *Lilium* and *Nomocharis* species, so I hoped to see these growing in the wild and learn more about their preferred conditions as a result. I also intended to document any other species of interest, particularly those that we grow in gardens in the UK, including non-native species which may be taking over from the native flora in North East India.

Start of the trail to Dzukou valley

ITINERARY

The actual itinerary diverged slightly from that we had originally planned, although not significantly. Below I have shown the actual itinerary:

4th November – Fly from London Heathrow to Delhi.

5th November – Fly from Delhi to Guwahati (Assam), then drive to Shillong (Meghalaya).

6th November – Explore around Shillong. Meet with Dr Ashiho Mao, Regional Director of the Botanical Survey of India.

7th November – Drive to Elephant Falls, Wakhaba Falls and then on to begin our trek to see the "living bridges" of Meghalaya. Overnight stay at Nongriat village near the "double decker" living bridge.

8th November – Return journey from the "living bridges", trek back to our vehicle. Then Khasi Hills and Nohkalikai Falls in the afternoon. Visit Sohra (also known as Cherrapunji), which has the highest rainfall of anywhere on earth.

9th November – Drive through West Jaintia Hills district in Meghalaya down to the border with Bangladesh on the Umngot river. Drive back through East Jaintia Hills to Jowai, then return to spend the night in Shillong.

10th November – Drive to Kaziranga National Park in Assam, stay in hotel overnight.

11th November – Jeep Safari around Kaziranga National Park in Assam (a reserve covering 170 square miles consisting of tropical forest, grassland and marsh)

12th November – Visit Kaziranga Orchid and Biodiversity Park in morning, then drive to Kohima, the capital city of Nagaland. Stay at Nino's "Greenwood Villa" outside Kohima (Kisama village).

13th November – Hike up Mount Japfu (3048 m asl, second highest peak in Nagaland), then back down the same day. Stay at Nino's in Kisama village.

14th November – Climb Pulibadze peak, then visit the traditional Naga village of Khonoma.

15th November – Hike to Dzukou valley (the "Valley of Flowers" on the Nagaland/Manipur border). Camp overnight in Dzukou valley.

16th November – Botanising in Dzukou valley (around 2400m asl, famed for its biodiversity).

17th November – Visit to Kigwema, a traditional Naga village.

18th November – Drive to Imphal (capital of Manipur).

19th November – Drive from Imphal to Ukhrul (1662m asl) in Manipur, then on to Khangkhui Hill (2200m asl). Camp overnight.

20th November – Botanising on descent from Khangkhui Hill to Khangkhui village. Walk back to road and then drive back to Imphal.

21st November – Day in Imphal, sight-seeing and preparing for journey home.

22nd November – Fly from Imphal back to Delhi, via Guwahati.

23rd November – Fly from Delhi to London Heathrow.

JOURNAL OF THE EXPEDITION

The following is a day-by-day account of the expedition, focusing mainly on the most important botanical findings but also including my observations and reflections on the parts of North East India which we travelled through. I have illustrated it with photos where relevant. Important findings and general learnings for the future I have highlighted **in bold**.

Sunday 5th November

As we flew into Guwahati airport on Sunday morning, the weather was sunny and warm (about 26°C) which was to set the tone for most of our trip. Although this part of India has perhaps the **highest rainfall on Earth** (particularly in Meghalaya) and one of the heaviest monsoons in living memory had only finished about three weeks earlier, I was surprised at how dry the climate was throughout our trip. There is certainly a **very marked contrast between the wet season and the dry season** (unlike the climate in Cornwall which I am used to!). Not only was the weather dry, but there seemed to be very little standing water even a few weeks after the monsoon, so the land must drain very quickly.

The connecting flight from Delhi to Guwahati had been short and pleasant. It was very impressive to see the Himalayan mountains, poking above the clouds and gleaming in the sun, from the plane's window on our journey. Almost as impressive was the number of rivers flowing south from the Himalaya towards the mighty Brahmaputra, which perhaps goes some way to explaining how the land is able to drain so quickly following the monsoon.

At Guwahati airport, we were met by Joe and Reggie, who were to be our guides and drivers for the next two and a half weeks. Both were from the Khasi tribe and lived in Shillong. They were very cheerful and helpful and spoke good English. We took a brief excursion to drive across the Brahmaputra – even at this point it is a truly colossal river, although it is even wider further north in Assam – and then began the long drive to Shillong, the capital of Meghalaya.

Guwahati airport is only 50m above sea level (asl) whereas Shillong is around 1,500m asl so it was a fair old climb, and it was not long before I had been bluntly introduced to another 'constant' of this trip: the joys of driving in India. Although the road surface (in this area at least) was fairly good, the attitude of most people using the roads was cavalier at best! Within a few minutes I had seen nearly every rule of the Highway Code transgressed, including children driving tuk-tuks, other people driving the wrong way down a six-lane highway, and a very narrow escape for a runaway goat! Luckily, our driver Reggie took this all in his stride and I soon learned to be more relaxed, or at least stoic, about the imminent dangers on the road.

Although the ground was dry and dusty in places, the vegetation everywhere was lush and there was a cornucopia of crops and fruit being grown in the fields, which took my mind off the huge trucks we were dodging between. Before Shillong, we stopped off at a lovely park on the shores of Lake Umiam. This was really just a municipal park, but it was great to see plenty of large exotic trees growing there. Most of these were introduced, but they included many large *Grevillea*, the biggest *Araucaria heterophylla* I have ever seen, *Cassia/Senna* and *Podocarpus*. Perhaps more exciting in our quest for native species was *Cephalotaxus griffithii* – a fairly rare species and new to me, which should be found growing wild in this region of NE India. Most of the species here would not be hardy outside in the UK, but it was interesting to see them nevertheless, and it shows what can be grown in this warmer, wetter climate.

We then drove on to the Sha Ri Loum guesthouse outside Shillong, where we stayed the night.

Monday 6th November

In November in this part of India, it **gets dark before 5pm but it gets light around 5.30am**, so I realised that I would need to make the most of the mornings on this trip. I took an early morning stroll from the guesthouse and it soon became clear that introduced plants were not only to be found in parks and gardens: I found *Lantana camara* everywhere, a very pretty little flower from Central and South America but flourishing as a weed here, as in many other countries. The garden of our guesthouse featured papaya (*Carica papaya*) and *Euphorbia pulcherrima* (red and white poinsettia, but much larger than the Christmas decorations!) – also American imports.

In terms of natives, *Pinus kesiya* (Khasi pine) was everywhere, as one might expect in the Khasi Hills. It is obviously planted for timber as well as growing naturally. *Alnus napaulensis* is also quick to occupy any disturbed ground – all of the forest here was secondary forest and fairly poor in species. My favourite plant on this morning walk was growing on the wall of our guesthouse: *Ficus pumila*, a tiny, climbing fig with enchanting foliage (probably naturalised rather than native). It was amusing to think that the following day we would be walking over living bridges made from their giant relatives, *Ficus elastica*!

Ficus pumila

After breakfast, we travelled into Shillong to meet Dr. Mao at the offices of the Botanical Survey of India (BSI). Dr Ashiho Mao is a self-taught botanist from Arunachal Pradesh, now the Regional Director for BSI covering this whole region of NE India (including Arunachal Pradesh). He is also acknowledged as the expert on local rhododendrons, and has recently published a book on the subject ("Rhododendrons of North East India: A Pictorial Handbook", A.A.Mao, S.S.Dash and P.Singh, Botanical Survey of India) which he was happy to give John Anderson a copy of. We showed him photos of some of the species of rhododendrons which we grow in the UK, which he seemed excited to see.

He also showed us tantalising photos of rhododendrons from both Arunachal Pradesh and East Manipur which could be new species or at least natural hybrids? Unfortunately, we would not be visiting these regions on this trip, but worth bearing in mind for the future.

According to his book, by far the **richest region in terms of rhododendron species is Arunachal Pradesh**, with only a handful of species to be found in the areas we would be visiting on this trip. We had known this from the outset, so it was good to have it confirmed. Dr Mao was able to give us some pointers on where we might have the best chance of finding these species. He also gave us some fairly vague directions on where to find the only known specimen of *Rhododendron wattii*, which was in Dzukou valley in Nagaland.

Dr Mao then gave us a tour of the BSI gardens around his office. It was here that I started to get an idea of the vast number of endemic species of orchids to be found here: *Dendrobium*, *Coelogyne* and *Epidendrum* were all flowering, as well as *Pleione praecox* and the spectacular *Vanda coerulea* (just starting to go over, sadly). But my favourite, which was to become perhaps the signature flower for our entire trip, was *Paphiopedilum insigne*. This is the State Flower of Meghalaya, but we saw it growing in cultivation throughout this trip. It has a beautiful, large and long-lasting flower. Here it was growing in profusion on a steep mossy bank in semi-shade, and was reproducing well with tiny little seedlings growing everywhere, but we later saw it growing well in pots and even as an indoor houseplant. I believe it is very rare in the wild, listed as Endangered on the IUCN Red List. But it is clearly doing well in *ex situ* conservation both here at the BSI in Shillong, and in houses and gardens throughout NE India. I think the problem is that, as became obvious later in our trip, any valuable orchids tend to be over-collected from the wild here in India. There is a thriving and lucrative "cottage industry" among local people in collecting them, and legal protection is not enforced. Until that is tackled, then any attempt at reintroduction is likely to fail.

Anoechtochilus roxburghii

After Dr Mao's tour, we exchanged gifts and it felt like the foundations had been set for future co-operation. Hopefully at some point we could persuade him to visit the UK for an international conference or seminar on rhododendron conservation? It would certainly be helpful to encourage greater international co-operation in this field. We then travelled back to the shores of Lake Umiam, where the Botanical Survey of India has a much larger botanic garden (BSI Umiam).

We were shown around BSI Umiam by a colleague of Dr Mao's. Here we really got an idea of what the forests of Meghalaya might once have looked like, before so much was cleared: full of lush foliage, orchids and giant bamboos. There was much to see, so I will simply list the highlights below:

- It was explained to us that there are **over 850 species of orchids in NE India alone** (with possibly new ones still waiting to be discovered in Arunachal Pradesh), compared with 1400 species in the whole of India. This represents an astonishing diversity, and there were many examples being grown here at BSI Umiam. Many were not flowering at this time of year – the best time to see them would be April to June. My favourite here was the Jewel Orchid (*Anoechtochilus roxburghii*) – the flowers are fairly insignificant but the leaves are incredibly patterned with pink veins. Unfortunately, it is nearly extinct in the wild, but there seemed to be a decent *ex situ* population here.
- There was also a thriving breeding population of the pitcher plant *Nepenthes khasiana*, which is listed as Endangered by the IUCN. It appeared to be fairly easy to propagate. This is the only Nepenthes in India and only found here in Meghalaya. This species was to assume greater significance later in our trip.
- As a fan of aroids, it was great to see *Colocasia gigantea* growing here with its spectacular large leaves. Also, *Remusatia pumila* was growing in moist leaf litter – a species which I cultivate in a greenhouse at home for its wonderful foliage.
- I was surprised to see a grove of *Cyathea gigantea* (the native species of tree fern) growing at the botanic garden. We are able to grow a few species of tree ferns in Cornwall, so they are not unfamiliar, but it was not a plant I associated with India, for some reason. Now I know better.
- There were several gingers fruiting – weirdly some seemed to fruit from the base of the stem rather than the tip, where I would expect the flower to be. Apparently though some species do flower at ground level. One such example was *Zingiber murlenica*, known from only a single location in Mizoram and described to science in 2015.
- *Magnolia hodgsonii* – not flowering of course but the leaves alone were incredible: glossy green and huge. Unfortunately, it is totally tender so not suited to the UK climate.
- Finally, I have to mention the enormous bamboos we saw here. There were several species here and apparently they were often dominant plants in the sadly-lost pristine forests of NE India. Here we had a glimpse of how those forests might have looked: awe-inspiring! The largest species we saw was *Dendrocalamus hookeri*, maybe 20 metres tall! A good 15cm diameter too. As an interesting aside, the botanic garden were using **sawn sections of these massive bamboos as plant pots for propagation, as a sustainable alternative to plastic.**

Bamboo sections used as pots as an alternative to plastic

Paphiopedilum insigne growing at BSI Umiam

Tuesday 7th November

We drove to the famous "living bridges" of Meghalaya, stopping at a couple of tourist spots *en route*:

At Elephant Falls we saw a small-leaved form of *Rhododendron arboreum*, several plants growing on rocks in more-or-less full sun. Not how I would expect to see rhododendrons growing at all – especially as the rocks carved out by the waterfalls here are limestone!

At Wakhaba Falls we saw *Buddleia forrestii*, *Melastoma* species and some enchanting bifurcated ferns of an unknown species. Also more rhododendrons, most likely *R. arboreum* again.

As before, I was struck by how dry the grassland looked here – waterfalls aside – considering the rainfall this area gets. I suppose the limestone bedrock makes it very easy for the water to drain away. But then, how **odd to see rhododendrons growing on limestone when everything I have ever learnt about them classifies them as calcifuges (ericaceous)**.

We walked down a series of steps to the living bridges, through sub-tropical forest. We visited three different living bridges and I have to say they did not disappoint. They are fantastic structures, built to cross fast-flowing rivers and gorges, which are made from the interwoven aerial roots of Rubber Trees (*Ficus elastica*). Amazingly, a sapling is planted on each bank but their roots will not join for maybe 10-20 years, and not form a sturdy bridge that will take pedestrians for 30 years or more. The roots are trained over the river on ropes and continuously woven together to form a strong and sturdy structure. Wood, bamboo and stones may be added to form the footpath, but the rest of the bridge is made from just the living roots from the two mature trees. Apparently, the reason for doing this is that timber/rope bridges would rot too quickly due to the extremely high rainfall in this region.

Structure of a "living bridge": woven from the aerial roots of *Ficus elastica*

One bridge, called the Long Root Bridge, is 95 feet (29m) across and 75 years old. But the most spectacular, and most famous, is the "Double Decker" (see cover sheet for a photograph). This is only 40 feet (12 metres) across but there are two spans, one above the other – presumably this dual carriageway is not needed due to volume of traffic! They are now creating a third span above the other two, which will take another 20 years. The existing Double Decker is over 200 years old and the trees from which it grows are 300 years old. I was so amazed to see these structures, having seen them on TV and in magazines before; it is something that will stay with me forever. And I have a newfound respect for the humble rubber plant!

Sadly, this famous tourist attraction has been detrimental to the state of the forest around it. I did see some interesting plants, including orchids and some unidentified araliads with spiny stems and beautiful leaves. There was an amazing profusion of mosses and epiphytes. This was the first time I had walked through subtropical forest so it was very interesting, but the feeling was of disturbed secondary forest rather than pristine forest. The vegetation had been cleared near the paths (to keep leeches away from tourists) and there was a problem with litter, particularly plastic bottles and wrappers. More tourism will only make this worse, though local people are trying to keep on top of the litter problem as tourism is their livelihood.

We stayed in Nongriat village (near the Double Decker) that night. There was certainly no shortage of nocturnal insectlife – in fact there was a huge diversity of moths and other insects attracted to the artificial lights – but it became clear that there was a problem with over-hunting by the local people. In fact, the forest was nearly hunted-out with very few monkeys, deer, squirrels, snakes, birds or any large mammals – all are eaten by the local tribe. However, there was one piece of good news: the state government had wanted to build a road to allow tourists to drive all the way down to the Double Decker. This would have been a disaster for the forest in terms of volume of visitors. However, the villagers of Nongriat organised an online petition to oppose this which gathered international support, and eventually the government capitulated.

Wednesday 8th November

We walked back up the hill from Nongriat to our vehicle by a different route to that we had come down. This took us through more interesting forest, but it was obviously still heavily-hunted. A fact underlined by the fact that we met a man collecting wild honey from up in a tree. There were plenty of butterflies and other insects, but no monkeys and very few birds. This must, of course, be detrimental to the whole ecosystem – including seed dispersal of the plants. One particularly interesting plant was a *Lycopodium* species, about 30-40cm tall, looking somewhere between a moss and a fern.

We got back in the car and drove through the dry grassland of the Khasi Hills. There was little of botanical interest here. When we stopped at Nohkalikai Falls one could see remnants of the forest which must have covered these hills in the gorges and clefts in the rock, but it was too steep to get down to explore these. We could see *Rhododendron arboreum* and *Exbucklandia popolia*, with its distinctive foliage. I also found a very pretty *Lobelia* species flowering in the grassland. But the overall feeling was of a dry and degraded environment – much of the land given over to quarries, coal mines and cement factories.

In the evening we visited Sohra market. Sohra is the correct local name for Cherrapunji – famed as the wettest place on earth. The average annual rainfall is 11.8 metres although in some years it has topped 20 metres! To compare, the average annual rainfall in Cornwall is just over 1 metre, so Sohra gets at least 10 times more rain. This rain is concentrated in the June-October monsoon, when travel

in this area becomes very difficult. Interestingly, it is very windy but relatively dry in April-May and this is a good time to see many plants in flower, including orchids and rhododendrons. This is worth bearing in mind for future expeditions to NE India: **April and early May could be the ideal time to see more plants in flower.**

Interestingly, Sohra is the historical name for this area. Cherrapunji is a name made up by the British, with no local heritage or authenticity. The British also moved the administrative centre for Meghalaya from Sohra to Shillong when they took control of the region, because Shillong had a more amenable climate (cooler and lower rainfall, though that is relative).

Sohra market had lots of lovely fresh produce: pineapples, oranges, bananas and vegetables all grown locally. I was interested to see *Colocasia esculenta* being sold as a vegetable, as I am trying to establish this as an ornamental in the garden at Trelissick (the big leaves give a fantastic tropical feel). The tubers, leaves and petioles of *Colocasia* are all eaten, which I find surprising as they contain crystals of oxalic acid which is an irritant and can cause the throat to swell up. Apparently the secret is to boil or steam them for a long time, and never to stir when cooking them.

Pleione praecox at Sohra market

Also, in the market we met a woman who was carrying a *Pleione praecox* she had just collected in the forest nearby, as a present for a friend. This seems harmless enough (it is fairly common as a species), but this was a pattern we saw time and again throughout our visit and this kind of casual, as well as commercial, **collection must be depleting the natural populations of many orchids in NE India**.

Paphiopedilum insigne growing in cracks in a wall, Sohra, Meghalaya

On the positive side, we visited a lady's garden where she proudly showed us her collection of epiphytic orchids (I did not ask their provenance). She had quite a collection of *Paphiopedilum insigne* in flower, some were even growing in cracks in the wall! I wonder what the painstaking British orchid-grower would make of that cavalier attitude – they are quite a valuable orchid in this country. I guess the **ideal climate in Meghalaya means that growing these orchids is relatively easy** – it is their homeland after all.

Thursday 9th November

We drove down through the West Jaintia Hills district to the border with Bangladesh on the Umngot river. There was little to see of botanical interest, although we did see a lot of betel nut palms (*Areca catechu*) with their characteristic dead-straight, slender trunks. Though not native, betel nut is a staple crop in southern Meghalaya; it is a mild stimulant and harmful to health (carcinogenic) but widely-consumed in India. Our driver Reggie chewed it regularly, giving his teeth a red tinge! The nuts are picked and then either sold whole or placed in huge woven baskets where they are soaked in running water for a month or more, then peeled before being sold. We actually saw trucks loaded with just these nuts, so clearly demand is huge.

It was interesting to see the Umngot river with the flat expanse of Bangladesh beyond it. The river was surprisingly clear and blue, considering the amount of sand and silt deposited here. Incredibly, considering how wide the river is here, apparently it can rise 10m during the monsoon.

We drove back through the East Jaintia Hills – again they were mostly deforested and poor in vegetation, although we did see some interesting plants including the magnificent fishtail palm

(*Caryota*) with its stately, huge fronds. We also saw *Luculia gratissima* flowering, which was a fairly common sight on this trip. But the stand-out plant on this return journey was *Nepenthes khasiana* growing in the wild, just beside the road. Having seen this Endangered pitcher plant growing at the botanic garden at Umiam, it was amazing to see it growing in its natural habitat. It was quite extensive with many pitchers visible, due to its rambling habit it was impossible to tell how many plants there were. However, seeing this alone made the trip worthwhile.

Nepenthes khasiana growing wild

Back in Shillong later, we were discussing the impoverished and deforested nature of much of the landscape here in Meghalaya, due to development. It transpired that the Garo Hills region of Meghalaya has the most intact vegetation. Unfortunately it is a no-go area due to the Garo tribe's insurgency and criminality in the area, including kidnapping. In fact, both our drivers had been kidnapped there previously, though not for long. Apparently, the deep forest found there is used by the insurgents to hide in. The Garo tribe are very different to the Khasi and Jaintia tribes and many Garo would like their own independent state. It sounds a very lawless area at the moment, but **when it becomes safer to visit it sounds as though the Garo Hills could have more to offer botanically**.

Friday 10th November

We visited the Ever Living Museum in Shillong in the morning. This museum incorporated a botanic garden with a large collection of well-grown orchids, both in pots and growing as epiphytes. All were native to NE India and the standard of horticulture was high.

Plenty of the orchids were flowering here and, apart from *Paphiopedilum insigne*, the ones that really stood out were: *Cymbidium elegans* (I would never have guessed this was a Cymbidium, totally different flower to what I am used to), *Coelogyne barbata*, a beautiful *Calanthe* species, *Dendrobium amplum* and the recently-described *Dendrobium arunachalense*. The latter is one that Dr Mao had mentioned to us: it was previously classified as *D. longicornu* but this form (from Arunachal Pradesh) has a slightly different flower morphology, and has been given species status.

Then it was back into the car for the long drive to Kaziranga in Assam. We had some difficulty finding the hotel and arrived in darkness.

Dendrobium arunachalense growing at the Ever Living Museum, Shillong

Saturday 11th November

This part of Assam is only about 40m asl. The low altitude means that it is more humid, lush and tropical than the hills of Meghalaya. The people in Assam are ethnically different as well, being predominantly Hindu. They look quite different to the Khasi and Jaintia tribes we had encountered so far, and dress differently too. Assam remains an important area for growing tea and we saw plentiful plantations of *Camellia sinensis*.

Kaziranga is an important wildlife park covering a large area (about 170 square miles). It is predominantly wetland with vast areas of marsh as well as broadleaf tropical forest and tall elephant grass. It is an important tourist attraction and it is good to see that the park authorities strictly control entry to the park. In fact, tourists are only allowed into a relatively small proportion of the park, with much of the protected area devoted to the wildlife. It is an important reserve for tigers and is home to two-thirds of the world's population of the Indian one-horned rhino.

We took a jeep safari in the morning and saw plenty of wildlife, including deer, elephants and several rhinoceros. There was not a great deal of botanical interest as the vegetation was mostly marshland with occasional trees, and we had to stick to the roads through the park. However, we did see some very attractive red lotus flowers (*Nelumbo nucifera*) – these seem to open and close in a short space of time, depending on incident sunlight.

Cymbidium elegans

<u>Sunday 12th November</u>

We visited Kaziranga Orchid and Biodiversity Park in the morning. This is a co-operative conservation venture (not a government-run operation) where they grow a huge number of tropical and sub-tropical orchids: around 600 species. We had a guided tour and, when the staff realised that John Sutton was something of an expert on orchids, we were also allowed to look "behind the scenes" with one of the horticulturists there.

Most of the orchids were not flowering at this time of year, again April-May is probably the best time to see the majority of them in bloom. However, there were several flowering including *Cymbidium*, *Gastrochilus*, *Dendrobium chrysanthum* and perhaps my favourite was *Pleione maculata*. Although not in flower, I was interested to see *Vanilla borneensis*: a rare, endemic vanilla orchid restricted to just two locations in Assam.

Pleione maculata

My impression was that there was a high standard of specialised cultivation at the Kaziranga Orchid Park and I picked up some useful tips:

Many epiphytes were grown mounted on mossy logs or bark, or coconut husks. Often, they were tied in place and misted heavily, but with good ventilation (often suspended in mid-air).

For terrestrial orchids and some epiphytes, the following mixture of media were used in varying proportions. Generally, **sharper drainage and terracotta pots were used for the epiphytes, and plastic pots for terrestrial species**. Orchid potting media:

- **Broken pieces of brick or tufa**
- **Coconut fibre (coir) or coconut husk**
- **Pine bark or broken pieces of tree fern stem**
- **Charcoal**

This type of mix would be ideal for *Cymbidium* or *Paphiopedilum* species. It is interesting that they did not use sphagnum or other moss in most of their pots, as many UK growers do. I wonder if this is simply down to availability, maybe moss is not readily-available in quantity? After all, it would not be practical for most UK growers to use tree fern stem but here they had a ready source. Possibly they do not need moss to retain moisture as there is so much rain during the monsoon, but then what about in the dry season? The above media all seem quite free-draining with little to retain moisture, but maybe that is what many orchid species need? I am not experienced enough to know.

For Pleiones the best medium to use is leafmould with some bark chips added, growing them in terracotta pots. Water them really well when they are rooted and growing – water every day. But when the leaves start to die back, stop watering altogether and allow them to dry out naturally.

Keep the dormant bulbils fairly dry or even lift them and store in paper bags (this is during our winter, the Indian "dry season").

Cymbidiums, it seems, can generally grow as either epiphytes or terrestrial orchids. In fact, on this trip I observed that the same species (e.g. *Cymbidium elegans*) appeared to be equally happy growing in a tree or in the ground, or in a pot with soil as the medium. This has implications for how I should grow them in the UK. A mix of the media listed above would probably work well, but what I have used **when I repotted recently (as a result of this learning) was 3 parts small-medium bark, 2 parts sphagnum moss and 1 part John Innes No. 3 loam-based compost. I used terracotta pots rather than plastic, as my Cymbidiums were previously in plastic pots and they seemed overly-wet.**

At the Orchid Park, they **water and/or mist heavily for all orchids when they are in growth, but ease up on watering when the plants are less active or dormant**. This often fits with the natural monsoonal cycle anyway. It must be borne in mind also that they are in the tropics and so evaporation will happen very quickly – I probably don't need to water quite so much in the UK, even in a greenhouse. Most of these wild species of orchids need very little feeding; at the Orchid Park they give a very weak liquid feed of a balanced NPK fertiliser, and only occasionally, or not at all for sensitive species. This makes sense as one would imagine that an epiphytic orchid growing in a crevice in a treetop would receive very little nutrients there – just occasional rotting leaves. **I have altered my feeding regime for orchids accordingly, and this year I will only give a balanced NPK liquid feed at one-quarter the recommended dilution, once a month when the orchids are in active growth – none at all when they slow down in winter.**

Having learnt a lot more about orchid cultivation, we climbed back into the car for the long, dusty, bumpy drive to Kohima in Nagaland. This was probably the worst road we had driven on so far, so it was quite a jarring ride. We were very glad to arrive at Greenwood Villa in Kisama village (just outside Kohima), run by a Naga lady called Nino who made us feel very welcome. We would be staying here for the next 5 or 6 nights, except for one night camping out. I was encouraged to see that Nagaland is very hilly and appeared to be more forested than Meghalaya, which meant we had a good chance of seeing interesting native plants and possibly some which would be hardy in the UK. It was certainly a lot cooler here at night than it had been so far on the trip.

Monday 13th November

This was our first day of proper trekking (rather than car-based botanising). We intended to climb to the top of Mount Japfu (Japvo), which is the second highest peak in Nagaland at 3084m asl. Japfu is actually very close to Kisama village where we spent the night (Greenwood Villa is located at about 1500m asl).

We drove a short distance to start our trek at around 1800m at the foot of Japfu. We were accompanied by three local guides. We walked up through cultivated land or allotments for the local village, where I was happy to see *Colocasia esculenta* growing as a crop. This is a plant which I am endeavouring to grow as an ornamental foliage plant at Trelissick and it was good to see pink-, dark- and green-stemmed forms growing here. I am not entirely clear what this plant requires in terms of water/drainage. One often sees it growing as a marginal or in flooded fields, but often those growing in water do not have the largest leaves, which is what is important to me in trying to get that tropical feeling when growing them in Cornwall. Here they were growing in fairly dry, free-draining soil but it is important to remember that the monsoon had only ended a few weeks earlier. The leaves on these plants were starting to brown and fade in the dry season. **I think when I try to grow them in**

Cornwall, it will be important to irrigate well in the summer (simulating the monsoon) but grow them on fairly free-draining ground so that they are not too wet in the winter, when they will go dormant. The tubers can rot very easily if kept wet when they are dormant. They are fairly tender to grow outdoors, even in Cornwall, but I have seen certain hardy forms grown outside successfully for a few years without any special treatment.

We entered a thicket of bamboo as we ascended the hill, which then opened out into broad-leafed evergreen forest. The dominant plant here (at around 2000-2500m) was *Quercus lamellosa*, along with other evergreen oaks (*Quercus*) and *Lithocarpus* species, and trees such as *Magnolia doltsopa*. What really struck me was the profusion of epiphytes growing in these trees: mosses, ferns and orchids such as *Bulbophyllum* and *Pleione*. Many epiphytic orchids had simply fallen out of the canopy to the forest floor, and it was possible to identify *Pleione humilis* and *P. praecox* (flowering) among them, as well as *Calanthe* species growing terrestrially. A lot of these epiphytes were showing signs of drying out, but the amount of growth in the forest canopy is testament to the high rainfall here during the monsoon, allowing so many species to live as epiphytes without much soil to root in. Presumably most of them survive the desiccation of the dry season and come back into growth as soon as the rains return.

The “forest road” on Japfu, which we had walked up

We stopped for a snack at a derelict hut/shelter at 2220m, then hit the wide forest road at around 2500m. From this stony track, we could see *Daphne bholua*, *Mahonia nepalensis* and, at an altitude of 2527m, our first Rhododendron: *R. elliottii*. This was a rather scrappy specimen, but we found more *R. elliottii* nearby. As we slowly ascended, we also found examples of *R. arboreum*, *R. maddenii subsp. crassum* and then, at 2650m we saw our first *R. macabeanum*.

Rhododendron macabeanum seedling on Japfu

Rhododendron macabeanum growing epiphytically on Japfu

Mount Japfu is the location from where Frank Kingdon-Ward first collected *Rhododendron macabeanum* in 1927 (Church & Smith, 2015). It is a plant I am familiar with as we have several specimens at Trelissick, and its broad, dark-green leaves are very distinctive. In the range between 2650-2800m it was fairly common and in fact it was probably the dominant species in this zone. There were impressive stands of *R. macabeanum*, some were very old and gnarled and up to 15 metres tall – far bigger than I have ever seen them before! They appeared to have survived the fire three years earlier; there were signs of fire damage but even the damaged trees were recovering and putting on new growth. Additionally, we saw plenty of *R. macabeanum* seedlings at this altitude, some even growing epiphytically on their bigger relatives. It seems that the population of *R. macabeanum* on Mount Japfu is fairly safe for now, although it has no legal protection here as far as I can tell.

One of the objectives of this study trip was to ascertain what the effect had been of building the "forest road" on the flanks of Mount Japfu. This was a new development when John Anderson had visited Japfu a few years earlier and the concern was that it might be opening up the forest on Japfu to greater exploitation. We had walked up this stony track for much of its length, until it petered out at around 2700m, where we stopped for lunch, surrounded by magnificent macabeanums. **I am glad to report that we saw no evidence of the new road resulting in greater exploitation of the forest here. In fact, it was slowly being reclaimed by the forest and we found many rhododendron seedlings growing in the gravel surface.** An unintended benefit of this gravel track was that it was giving seedlings a chance to get going in the cleared space, without having to compete with adult plants for light. The free-draining surface of the gravel track had created a perfect seedbed for rhododendron seedlings and they seemed to be growing really well. **I will remember that they need very sharp drainage next time I am sowing seeds of rhododendrons.**

Unfortunately, because we had spent so much time botanising on our ascent, we did not have time to reach the summit of Mount Japfu. We were concerned about getting back to the vehicle before dusk. Therefore, at around 2800m we decided to turn back down the mountain, continuing to botanise as we descended. We found a further two species of rhododendrons near the top of the mountain: *R. triflorum var bauhiniiflorum* and *R. vaccinioides* (growing as a tiny epiphyte). It was interesting to note the zonation of vegetation as we descended: higher up there were more deciduous trees e.g. *Acer campbellii* and *Sorbus*, whereas below 2500m the vegetation was mostly broad-leaved evergreen.

Perhaps the most impressive of the deciduous trees we saw was *Sorbus keenanii*. This had scarlet autumn colour and was often growing as an epiphyte - sometimes as quite a decent-sized tree: a tree growing in another tree! It was quite an arresting sight to see this broad swathe of scarlet against a background of green, where *S. keenanii* was growing in an evergreen host, a beautiful contrast. The fact that a sizeable tree was able to grow as an epiphyte is again a sign of just how much rainfall the region gets.

Although Japfu has fairly dense and undisturbed, mixed forest, I was disappointed that we saw no monkeys and hardly any birds on our visit. I think that sadly this is probably due to over-hunting again. The local Naga men hunt birds and monkeys with catapults, and our guides showed what devastatingly good shots many of them are (although our guides were not firing at living targets!).

Sorbus keenanii growing as an epiphyte in an even larger tree on Japfu

Tuesday 14th November

We had an easier trek organised for today: climbing Pulibadze, which is a hill near Kohima town. Pulibadze is a small nature reserve which you have to pay to enter.

We parked the car at the car park, around 2065m, and then began a gentle climb. *Rhododendron arboreum* was plentiful here, right the way to the top of Pulibadze (around 2220m). The slopes of the hill are wooded with evergreen broad-leaf trees and there were plenty of orchids growing as epiphytes, including *Bulbophyllum*, *Chiloschista* and *Pleione praecox*. Also, we found one orchid species flowering near the car park which we were unable to identify, even to genus level.

The most exciting find, from my point of view, was the first (and only) *Arisaema* which we found on this trip. *Arisaema tortuosum* was growing plentifully in the dappled shade and leafy soil on the slopes of Pulibadze. I had seen none the previous day on Japfu, and I wondered if they had been over-collected there, or maybe it was due to the depleted birdlife on Japfu? There certainly seemed to be more birds here on Pulibadze (where they had protection from hunting) and so maybe the birds were doing a better job of dispersing the seeds of the Arisaemas? Many of the *Arisaema tortuosum* here had fruits on them, but they were all green and not red (which the ripe fruits would be). So maybe all the ripe, red fruits had been eaten by the birds as soon as they were ready, and were being dispersed as they should be, which is why there were no red fruits to be seen.

Again, I was struck by the contrast between the wet season and the heavy rainfall which allows all the abundant epiphytes to grow here, and the dry season which meant that now, only a few weeks after the end of the monsoon, the ground appeared very dry and most of the epiphytes were turning

brown. **This makes a great deal of sense in terms of what I know about cultivating species such as *Pleione* and *Arisaema* back in the UK: they need copious watering when in growth, and then need to be kept dry as soon as they start to die back, otherwise they can rot. This underlines the fact that I need to simulate the monsoonal wet and then dry seasons when growing these species back in the UK.**

After Pulibadze, we visited Khonoma village which is a very traditionally-run Naga village, part of the Angami tribe. It was very peaceful and picturesque, and many of the houses were in the traditional style. I was struck by the huge numbers of orchids which festooned many of the houses in the village; obviously many of the people here are excellent amateur horticulturists. There were species such as *Cymbidium mastersii*, *Cymbidium ensifolium* and *Vanda coerulea*, often growing in old paint pots and oil cans, even a former microwave oven! I wonder what the dedicated UK orchid growers would make of such an approach, but it seemed to work well enough.

A large clump of *Arisaema tortuosum* growing on Pulibadze

<u>Wednesday 15th November</u>

We drove a short distance to start our trek up to the Dzukou valley, leaving the vehicle at around 2350m. We had a guide (Akhudo) and three porters to help carry our stuff.

There was a climb of about 1000 feet on a steep path through unspoilt, primary forest. We saw lots of *Schefflera* and other Araliaceae as we ascended. There were also a lot of Rhododendron species: *R. maddenii subsp. crassum, R. johnstoneanum, R.elliottii, R. arboreum* and *R. macabeanum*. I was quite surprised to find *R. macabeanum* here as I had believed, erroneously, that it had only ever been found in two locations: Mount Japfu and Saramati, the two highest points in Nagaland. In fact, "it is native to Manipur and also the Naga Hills of Nagaland in north-east India and possibly into

Burma" (Church & Smith, 2015) and Frank Kingdon-Ward recorded it in Manipur near the border with Burma (Kingdon-Ward, 1952). It seems likely that R. macabeanum is to be found on many of the Naga Hills where there is intact forest and an altitude of at least 2450m (McQuire & Robinson, 2009), as it was here, and probably to the East as far as Burma (Myanmar). Here at Dzukou we were very close to the border with Manipur anyway.

We reached the top at 2677m after about one hour's walking. Here we were no longer in the forest, but in Dzukou valley proper. It was a strange, beautiful and slightly eerie landscape: there were many burnt, blackened trees poking out of a sea of dwarf bamboo. The topography was a mass of small hillocks and interlocking spurs giving a strange symmetry to the landscape. It seems like the bamboo probably catches fire very easily and the resident trees get burnt too, but they take a lot longer to recover than the carpet of bamboo, which is why these blackened sculptures remained. However, it was good to see that a few *R. macabeanum* were recovering from fire damage, proof of their resilience.

The strange landscape of Dzukou valley

There were little pockets of woodland throughout Dzukou valley, and here we found *Pieris, Sorbus*, *Micromeles* and *Rhododendron triflorum var bauhiniiflorum*. We arrived at the huts in Dzukou valley, where we would be spending the night, in less than three hours. The walking along the top was fairly flat and the path was well-used, although over-grown with bamboo.

After we had set up camp, we started to explore the wooded areas near the huts where the only known, wild specimen of *Rhododendron wattii* was supposed to be found. We had only vague instructions from Dr Mao on where to find this individual plant, but amazingly we did find it. It was fairly close to the huts and we were sure we had the correct plant as it had been cut down by about half for firewood, and then re-shot as Dr Mao had described it to us. We were really excited to find it at the time, but whether this was the genuine "Rhododendron wattii" or not became a moot point

when we got back to the UK. *Rhododendron wattii* is not really an accepted species, in fact it is a natural hybrid between *R. arboreum* and *R. macabeanum* and should probably be denoted as *"Rhododendron x wattii"*. Both parent species were in the vicinity, so our plant could well have been a hybrid. However, *R. wattii* is normally described as having broader, more oval leaves than our plant. Furthermore, and to add to the confusion, the following day as we walked back, John Anderson found another plant which seems to match the description better, and which he believes to be similar to a plant he has labelled as "R. wattii" which is growing at Windsor Great Park and which John received from Glendoick…. so the taxonomy is a little confusing. We can be fairly sure that we had at least found the plant which Dr Mao had identified as *R. wattii*. But if this is the only plant in the wild, that implies that this is not a very stable or widespread natural hybrid, and possibly it should just be viewed as an anomaly? Or maybe there are other plants the same hiding in the wooded valleys of Nagaland? In which case, the hybrid might have more relevance.

This is probably the plant which Dr Mao has identified as *Rhododendron wattii*

Thursday 16th November

It had rained heavily overnight and it was very misty and damp when we woke up – making the scenery even more spooky than on the previous day. We decided that it would be best to head back to Nino's rather than venture down into the valley botanising as we had planned. The visibility was poor and the wet weather made it likely that we would encounter leeches. This was a shame as I had hoped to see signs of the endemic Dzukou lily (*Lilium chitrangadae*) but obviously it was too late in the season to see any in bloom. Dzukou is sometimes called the "Valley of the Flowers" and I have seen photos which show it awash with colour, but the **best time to see everything in flower is June-July. I would like to return at that time of year to see the flowers, particularly the lilies (which look close to *Lilium mackliniae*), however it will be very wet at that time of year and apparently leeches are a real problem.**

The walk back through the forest was enjoyable. We noticed *Sorbus keenanii* growing epiphytically, and also a different species with larger leaflets which was probably *Sorbus wattii*. This was the first day of our trip where we experienced any rain. Obviously it was nothing compared with the heavy downpours of the monsoon, but it was interesting to see how the mist and rain coated everything in moisture. **I would imagine that these occasional wet days are what sustain the epiphytes through the dry season**. One more favourite plant I found on this return journey was *Rubus lineatus*, with its lovely leaves with a silvery underside.

Rubus lineatus leaf underside

<u>Friday 17th November</u>

It had rained heavily overnight and continued to drizzle all morning, with a thick mist covering the surrounding hills. We visited Kigwema village with Nino as our guide. This is a village of the Angami tribe, where many people still live in traditional houses (though some houses are modern in style). The people were very friendly on the whole, but it probably helped that Nino was related to several of them (Kigwema is very close to Greenwood Villa, where we were staying). Most of the people seem to live very traditionally, farming the nearby fields and rice paddies with hand tools on a subsistence, small-scale basis. However, the younger generation of Nagas (the Angami are a tribe within the Naga people) are more modern in terms of their clothes, haircuts and use of technology, so I think that this traditional way of life is probably on the way out.

It was interesting to see again that many of the people here are obviously skilled amateur horticulturists. Even quite basic little shacks had a splendid display of pot plants: orchids, pelargoniums, *Spathiphyllum*, all sorts. People were very keen to invite us in to show us their plants, and they all seemed to be grown very well.

Saturday 18th November

We said our goodbyes to Nino and then drove to Imphal, the capital of Manipur. The roads were subsiding or swept away by landslips in places – we had to avoid numerous potholes. However, it was sunny the whole way and it was lovely to see wild cherries (*Prunus cerasoides*) blossoming on the hills.

We stopped at the Manipur State Orchidarium *en route*. Here we saw some absolutely massive epiphytic ferns (not tree ferns) as well as the usual suspects in terms of orchids – all appeared to be thriving. Of those orchids which were flowering, perhaps the stand-outs were *Cymbidium elegans*, *Cymbidium ensifolium* and a lovely white *Coelogyne* species.

A large "antler fern"

Sunday 19th November

We had a long and bumpy drive from Imphal to Ukruhl, which is high in the hills of Manipur which stretch all the way to Myanmar (Burma). At Ukruhl we encountered a Catholic religious procession which seemed to involve most of the children in the town, I believe it was for Eucharist. This underlines the fact that most of the Naga people are Christian – not necessarily Catholic as there are a few different branches of Christianity which are represented here. Ukruhl has several churches. The local people are mostly Tangkhul, a tribe within the Naga people.

In Ukruhl we met our driver and two guides who would accompany us on our last trek of this expedition. We then embarked on what was certainly the most uncomfortable drive of my life, although this was entirely due to the condition of the road – our driver was extremely competent and coped admirably. The track we were driving on was extremely rough, not a road at all, and at one point we had to ford a river because the bridge had been swept away by floods. However, it was all worth it when we arrived in Khangkhui village, which was very pretty and quiet with amazing views. Here we had a really nice lunch, before the final drive to Khankhui Khunou Harva Khangai (or Khangkhui Hill). This was an even rougher track, which eventually became impassable due to a recent landslip. Therefore we had to carry all our kit and camping equipment for the last mile, so that we could camp on top of the hill at 2200m. Because it was getting dark, we did little botanising on the walk but decided to leave that for the following day.

Having made camp and built a fire on which to cook dinner, we got chatting to our guides Aso and Machin. Aso is very keen to build ecotourism to the Ukruhl region and further east. What particularly interested us was what he told us about the virgin forest in East Manipur, near the border with Myanmar. This forest is called Khamasom and is apparently almost untouched. It is very remote and takes a few days to get there, which means that an expedition there would need more than a week, maybe two. But it does sound worth exploring, and this chimes with what Dr Mao had told us about discoveries still to be made in East Manipur. **Aso is interested in organising an expedition to this area, so I will keep in touch with him and hopefully at some point in the future we will get the chance to explore the primary forest of Khamasom in East Manipur.**

Monday 20th November

We got up before 5am to watch the sun rise. The furthest range of mountains over which the sun was rising were actually in Myanmar, so we were fairly close to the border – maybe two days walk at most.

After breakfast we broke camp and began a leisurely walk back to Khangkhui village, spending a few hours botanising along the way. The flora was quite rich and varied. Below I have listed some of the most interesting sights:

- A wild, white *Camellia* flowering
- *Cornus kousa*
- *Cornus capitata* (also recorded by Kingdon-Ward, though he states it is "not common in Manipur" (Kingdon-Ward, 1952))
- *Malus* sp. fruiting
- *Ampelopsis*
- *Schefflera*
- *Magnolia doltsopa*
- *Cymbidium elegans* flowering (the first time I had seen this in the wild, although I had seen plenty growing in cultivation on this trip)

In fact, there were lots of epiphytic orchids to be seen in the forest we walked through, but also there was cause for concern. On the way down the hill, we met a group of men from Khangkhui village climbing up. They looked like a hunting party, but it transpired that their main quarry was usually orchids. In fact, their major source of income was from collecting orchids. Our guide Machin also derived much of his income from wild orchids, some of which he said he sold for the Chinese medicine market for quite good money. **It seems there was a thriving cottage industry in collecting wild orchids, and this was not simply a local phenomenon – we had seen signs of this in the nurseries, markets and gardens throughout North East India. The volumes in which these seem to be collected were significant, and I am sure they must be depleting the wild populations.** I think that the only way to tackle this is education. The problem is that most local people see the forest as an unlimited resource which they have always traditionally made use of, whether for hunting or collecting firewood or plants. Unless they are educated to hopefully change their attitudes, this will continue. The forests where we were in Manipur had no legal protection and the local people probably felt that they had every right to exploit them as they saw fit. In fact, on our walk we also saw large stretches of steep hillside which had been cleared of forest in order to grow crops. Obviously, the danger with this is that the soil would then wash away in the monsoon rains, leaving little soil or vegetation at all. But the people have always done this and probably see the forest as an inexhaustible resource, whereas in fact it is rapidly being lost or degraded. **Education could help to change this, as also could money from ecotourism, if this gets going in Manipur.**

New *Sorbus* leaves emerging. On the same day we had seen *Sorbus* leaves dying back and turning red in what we would call “autumn colour” in a temperate climate

On a more positive note, I observed a few things on this walk (and earlier in the trip) which made me curious about the seasonality of the plants in this part of the world. Unlike our temperate four-season cycle in the UK, in this part of India they have two or three seasons: the "dry" season, the "windy" season and the "wet" season or monsoon. At the time of our visit, the rains had finished maybe four weeks earlier and we were into the dry season. I had seen plenty of deciduous trees (on this day and earlier in the trip) showing signs of what we would term "autumn colour" and dropping their leaves. However, there were also some trees without leaves which were just coming into leaf, their buds bursting with fresh new leaves. And in some cases I even saw new leaves emerging on trees which were simultaneously losing their old, yellow leaves – a phenomenon which John Anderson termed **"semi-deciduous" behaviour (which I believe is an accepted botanical term, though new to me).**

In a similar vein, on this walk I observed a *Cornus* which was in full flower with no fruits, and then right next to that was another *Cornus* (apparently the same species) which had finished flowering and was producing green fruits. This was at exactly the same altitude and appeared to be the same species, which seems curious compared with what I am used to in the UK.

What this tells me is that I should be aware that **not all plants follow the same seasonal cycle, and often there are plants adjacent to each other which are at different stages in their growth cycle – even within the same species or genus. I guess that this is a feature of the sub-tropical/tropical climate where the divisions between the seasons are less marked than in temperate climates (with the exception of rainfall), and where temperature remains quite similar throughout the year. There is also the influence of altitude, where some plants become more deciduous at the cooler higher elevations.**

We returned to the car and then drove back to Imphal. Personally I would have liked to have visited Sirhoi, which was nearby and which I had read so much about in "Plant Hunter in Manipur" (Kingdon-Ward, 1952). It would probably have been botanically rich and interesting, although (as in Dzukou) the Sirhoi lily (*Lilium mackliniae*) would not have been flowering in November. However, we decided not to make the journey due to the time it would take driving on the terrible roads in this part of India. This was, perhaps, one of the important learnings from this trip: that we need to build in more time for driving than we imagined, because the time taken to cover a certain distance in India would always be far more than one would expect in the UK. This was mainly due to the condition of the roads, but also the traffic and the way people tend to drive in India. In total, we had probably driven about 800km (500 miles) on this trip, but it felt like a lot more! **I think if I was planning another trip like this to India, I would try to cover less ground and spend longer botanising and exploring in one or two locations, rather than driving too much.**

The problem is that driving even relatively short distances can take up a whole day, and that is effectively "wasted time" from the point of view of botanical study. So it is better to spend longer in each location, exploring on foot, and only to move on when you feel that you have fully investigated that region. Having said that, by covering a lot of ground on this trip we could probably exclude some regions from future expeditions, whilst identifying other areas which we would like to spend more time in (possibly at a different time of year?). **In fact, I have identified two areas which we did not visit but which I feel could be fruitful for future exploration: Arunachal Pradesh and Eastern Manipur, near the Myanmar border.**

We spent the next day in Imphal, and then began the journey back to the UK. However, there was little else of botanical interest to relate, so that concludes my account of this expedition.

The sun rising over the hills of Myanmar

CONCLUSIONS

In terms of the original four objectives set out in this document:

1. We had a successful and informative meeting with Dr Ashiho Mao which I hope will initiate a useful collaboration between India and the UK in the field of rhododendron conservation. It would be great if we could get him to come and talk at a conference in the UK in the future, which I believe was planned a few years ago but did not happen unfortunately. He would also be a useful person to contact if planning any further rhododendron-hunting trips to NE India.

2. It appears that the forest on Mount Japfu is recovering from the fire a few years ago. In fact, I was surprised at how well rhododendrons here and at Dzukou valley appeared to recover from fire damage. Furthermore, at the moment it does not appear that the "forest road" cleared on Japfu had resulted in the forest being destroyed, as had been feared. In fact, this road (which was mainly to demarcate the boundary between the territory of two villages) was being reclaimed by the forest and seemed to function as a successful seedbed for rhododendron seedlings. However, there remains the danger that this road allows greater access to the forest, which appeared to be heavily-hunted. One feels that the forest on Japfu (a famous beauty spot) ought to enjoy greater protection and that, if hunting was banned here, there would be a more fully-functioning ecosystem.

3. In total we managed to identify and photograph seven species of rhododendrons in the areas we visited, which is not far short of the total number expected according to Dr Mao's research (Mao, 2017). This does not include *R.wattii*, which is probably simply an anomaly, if we did even find it. The bulk of the many species to be found in NE India are restricted to Arunachal Pradesh. I learnt some new things about how some species grow in the wild, including that:

- Some unexpected species are capable of growing epiphytically (not just *R. vaccinioides* but also *R. macabeanum* and *R. arboreum*)
- Though usually classed as calcifuges, some rhododendrons (e.g. *R. arboreum*) are capable of growing on limestone
- To emulate their natural seasonal cycle, possibly species from these monsoonal areas would benefit from a very wet summer and a dry winter?
- Rhododendron seedlings germinate well given a very gritty, free-draining substrate

4. This trip was a good introduction to some of the genera of orchids to be found in India, and the bewildering diversity of species to be found there. I picked up some good tips on the cultivation of orchids and would like to expand my collection. I feel that this trip has increased my appreciation for orchids beyond the *Pleione* and *Cymbidium* species I normally grow, and I now have a bit more confidence in identifying those other genera too.

Clearly there is an issue with over-collection of wild orchids in NE India and this needs to be tackled through education. We saw a few places where even very rare orchids were being cultivated successfully. Not only does this give hope for *ex situ* conservation, but this knowledge and skill could be used to farm orchids commercially for both the domestic and international markets. This could bring money to a very poor part of India, and take the pressure off the wild populations of orchids.

There is also an issue with alien plants invading NE India. We saw several species of plants from the Americas growing wild which have no place there, including *Brugmansia*, *Euphorbia pulcherrima* and *Lantana camara*. However, it was good to see some native rarities hanging on, such as *Nepenthes khasiana*.

LEARNINGS AND PLANS FOR THE FUTURE

Beyond the original objectives set out at the start of the document, I feel that I have learnt several other things as a result of this trip:

It was interesting to see first-hand the contrast between the wet season and the dry season in these monsoonal areas. I was expecting the ground to be a great deal wetter than we found it, this close to the end of the monsoon. However, one could see from the amount of epiphytes growing in the forests that there must be very high rainfall – enough even to sustain trees growing as epiphytes in other trees. This has helped to inform my cultivation of genera such as *Arisaema*, *Lilium* and *Pleione*, which generally need plenty of water when in growth (our spring and summer) and then to be allowed to dry out as they go dormant in winter. This will also apply to the *Colocasia* which I am going to try to grow outdoors at Trelissick: they will need copious water in the summer (I am considering irrigation with a drip-hose) and then stop irrigation in autumn as they die back. Hopefully by planting them in plenty of woodchip, this will give better drainage to stop them rotting when they go dormant.

I also observed how occasional rain and mist in the dry season helps to sustain epiphytes, and this might suggest that occasional misting of epiphytic orchids when they are not in growth would be helpful. However, it is important to bear in mind the difference in temperature between winter in the UK and the "dry" season in NE India. Because it is so much cooler here, the misting will not evaporate quickly but will tend to accumulate in pots, so it is important not to over-water and keep the substrate of these orchids "slightly humid" not wet.

I picked up several tips on growing orchids both from John Sutton and the different botanic gardens we visited, which I have already started to put into practice.

I was interested to see that many plants in sub-tropical areas respond in different ways to the change in seasons, with some coming into leaf in the dry season whilst others are losing theirs. We even observed "semi-deciduous" behaviour where the same plant was losing its old leaves (as we might expect to see in autumn) as new ones emerged. This was all new to me and not something I had really ever thought about before, so it is interesting to see how seasonality influences plants in some sub-tropical areas.

It would be wonderful if more ecotourism could be encouraged in this part of India. There are some really beautiful areas left, but it is difficult to see how they can survive unless an economic value is attached to them. It seems like this has been done very successfully at Kaziranga, but areas such as Mount Japfu and Dzukou valley do not enjoy the same protection, and are degraded as a result. In a similar way, I think it would make a lot of sense both financially and from a conservation point of view, to establish orchid farms in this part of India. Clearly there is a lot of horticultural expertise among the people and the climate is ideal for the cultivation of orchids, so if they could be grown commercially and exported this would bring money into what is a poor and economically undeveloped part of India.

One thing I have learnt is that driving from A to B in India can often take a lot longer than you might expect. We only drove about 500 miles on this trip but it seemed a lot more. I think it is important to allow for this driving time when planning an itinerary in places like India, but also ideally to plan to minimise the amount of driving. I think it would be better, if I was planning this sort of trip in the future, to identify one or two really rich areas and concentrate on exploring them fully on foot, rather than trying to cover too much ground by road. One can lose entire days of the trip just on driving from one location to the next.

Another option I would like to explore is to visit this part of India (or somewhere else affected by the monsoon) in April to early May. Apparently, this is a good time to visit because many plants will be in flower, but it is not too wet with all the problems that can bring.

In terms of specific areas which I would like to explore in the future, I have identified a few as a result of this trip:

- The **Garo Hills in Meghalaya**, if and when it becomes safe to do so, because apparently they have the most intact forest left in this region.
- I would like to see **Dzukou valley and Sirhoi** in June-July when the lilies are in flower, partly for the spectacle but also because I would be interested to compare *Lilium chitrangadae* (Dzukou lily) with *Lilium mackliniae* (Sirhoi lily). They look quite similar so I would like to see what the differences are.
- The **Khamasom forest**, in Eastern Manipur near the border with Myanmar, sounds like it could be botanically rewarding, especially as it might be primary forest which is mostly untouched.
- **Arunachal Pradesh** is definitely somewhere I intend to visit. It has the greatest expanse of intact forest remaining in India, a huge variety of rhododendrons as well as other species such as *Arisaema* and many areas are virtually unexplored. Also, I know people who have already visited parts of Arunachal Pradesh and Oken Tayeng would be the best person to organise such a trip. Arunachal is relatively unspoilt but apparently the rate of change there is accelerating, therefore I would be keen to visit sooner rather than later.

Team photo before starting the trek to Dzukou valley (I am in light blue)

FINAL BUDGET BREAKDOWN

Funding received	
Donor	**Amount**
RHS Coke Trust Bursary Fund	£2,464
Merlin Trust	£1,020
Rhododendron, Camellia & Magnolia Group	£500
HPS Kenneth Black Bursary Scheme	£500
TOTAL AMOUNT RECEIVED:	**£4,484**
Outgoings	
Item	**Cost**
Accommodation/Food/Transport in SUV/Guide/Porters total cost = 2800 US dollars	£2,120
Return Air Fare Heathrow to Delhi	£575
Internal Flights (150 US dollars total)	£114
Return Train Fare Truro to Paddington	£111
Return Fare Heathrow Express	£37
Insurance	£85
Visa (77.63 US dollars)	£62
Vaccinations	£360
Water purification/insect repellent/hand sanitiser	£70
Mosquito net	£40
Electrical adapters/chargers	£38
Headtorch	£15
Digital camera	£440
Replacement batteries and charger for camera	£39
Dry bags/waterproof containers	£67
Trekking clothing	£230
Spending money	£150
TOTAL OUTGOINGS:	**£4,553**

As it seemed possible that I would not receive funding from the RHS Bursaries Committee, since the expedition was beginning on 4th November and the Committee were not due to meet until November, I made a "last minute" decision to also apply to the Merlin Trust, in case I was too late to receive funding from the RHS. Fortunately, my applications to both organisations were successful and, as can be seen from the detailed breakdown above, the money received from the Merlin Trust covered the expenses of equipment which I had planned to pay for myself. I am extremely grateful to all four of the organisations which were able to provide funding to cover the cost of this trip.

The breakdown above is a true and complete statement of the costs involved in this expedition, and of how the funding I received was spent.

Richard Holman

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- RHS Bursaries Committee with funding from the RHS Coke Trust Bursary Fund
- Merlin Trust
- Rhododendron, Camellia & Magnolia Group Bursary Fund
- Hardy Plants Society with funding from the Kenneth Black Bursary Scheme

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Vanda coerulea growing in Khonoma village