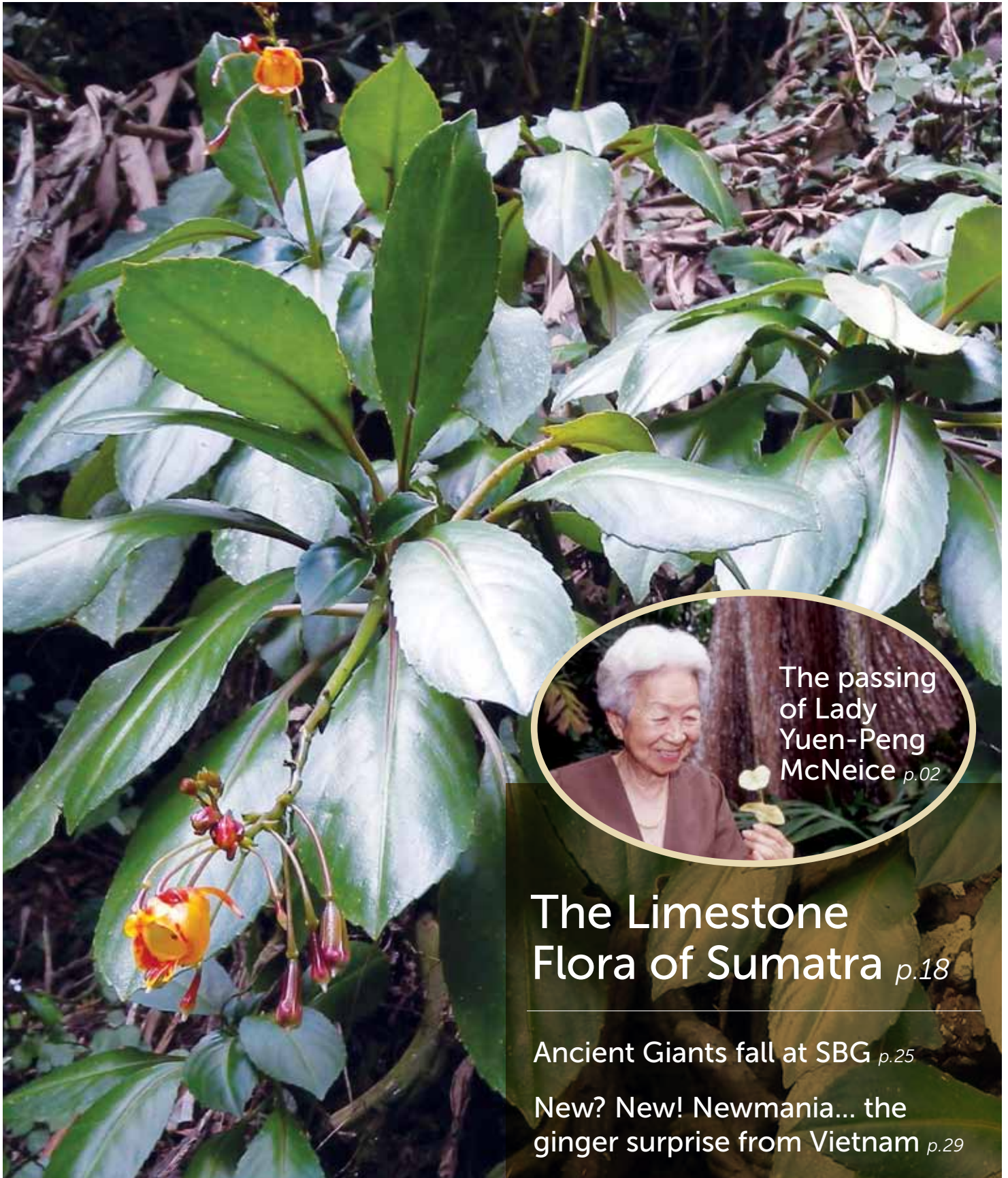


GARDENWISE



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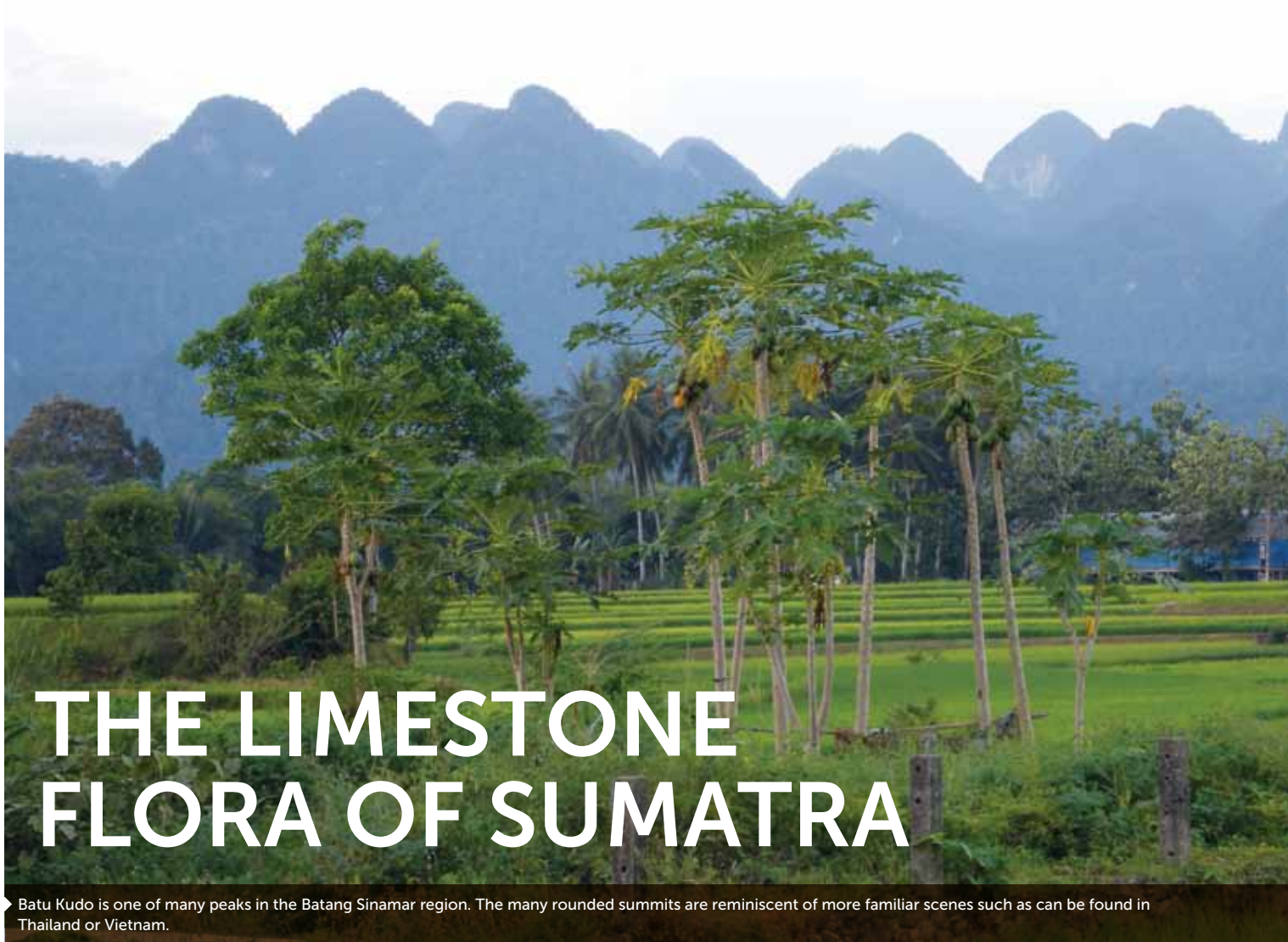


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THE LIMESTONE FLORA OF SUMATRA

▶ Batu Kudo is one of many peaks in the Batang Sinamar region. The many rounded summits are reminiscent of more familiar scenes such as can be found in Thailand or Vietnam.



▶ The soft character of limestone means it can be rapidly eroded, sometimes forming spectacular caves such as this one near Solok Ambah, West Sumatra.



▶ Limestone outcrops, shown here in red, are very scattered in Sumatra. Their archipelago-like distribution is no doubt important in permitting the evolution of many narrowly endemic plants on limestone.

Once a species becomes a limestone specialist and loses the ability to thrive on other types of base rock, the distribution of its populations becomes more restricted.



▶ A new species of *Begonia* discovered growing in cave entrances in Bukit Karang Putih a few kilometres away from Padang city.



▶ A striking new species of *Begonia* with very succulent leaves, found on the sheer limestone cliffs of Gunung Batu Kudo.



▶ A new species of *Begonia* found clinging to meagre and dusty soil on limestone rocks in Simolap, North Sumatra. This belongs in section *Reichenheimea*, and is allied to other species from Sumatra (such as *B. droopiae*) and from Peninsular Malaysia (such as *B. nurii* and *B. rajah*).

▶ Sumatra is one of the largest islands making up the archipelago nation of Indonesia. The combination of its equatorial position and mountainous backbone means it is home to some of the richest forests in Southeast Asia. Although much of its lowland forests have now been cleared (with the exception of the majestic Gunung Leuser National Park), its montane forests are in much better shape, and are ripe for botanical exploration. These forests are situated along the Barisan range of mountains which runs just behind the western coast of Sumatra. The mountains are the result of recent and rapid uplift caused by the subduction of the Indo-Australian tectonic plate, and their geological youth and activity are demonstrated by the 35 active volcanoes scattered throughout the range. The geological activity has also exposed many small blocks of limestone, which have an archipelago-like distribution within Sumatra. These limestone hills are incredibly rich in endemic plants and animals, and have been very accurately termed 'imperiled arks of biodiversity' due to their overexploitation by humans (Clements et al. 2006, *Bioscience* 56: 733–742). The reasons why we find such high numbers of endemics on limestone hills are not yet fully understood, but the fragmented nature of the habitat is likely to be one contributing factor. Once a species becomes a limestone specialist and loses the ability to thrive on other types of base rock, the distribution of its populations becomes more restricted. As seed and pollen dispersal is limited between isolated populations, there is a decrease in the influx of genes from populations that occur under slightly different conditions; as a result, individuals

adapt very tightly to highly localised conditions. Limestone hills also offer a variety of different niches, ranging from deeply shaded and sheltered to fully exposed and dry, as the rocks often become very dissected due to their highly erodible nature.

During the summer of 2011, the Royal Botanic Garden Edinburgh, Herbarium Bogoriense, and Kebun Raya Bogor carried out a joint six-week-long expedition to explore a number of limestone outcrops in Sumatra, with the expert support of colleagues from the University of Andalas in Padang. The main purpose of the expedition was to document and collect plants of special research interest for the participants, namely members of the Begoniaceae, Gesneriaceae and Zingiberaceae; collections of these and other families will be used to help in understanding the origins of the remarkable limestone flora of Sumatra.

The expedition began in Padang, initially exploring Bukit Karang Putih, an area located a few miles northeast of the city. This is a large expanse of limestone with sizeable hills, a large river, and several small caves. It is also home to the oldest cement plant in Indonesia, and much of the limestone hills are currently being quarried; this is the fate of many such areas throughout Southeast Asia, and is the main reason why limestone plants are of high conservation concern. At the mouth of a cave, we found our first new species of the trip, a *Begonia* with peltate leaves with a purplish centre. While the *Begonia* formed a dense colony of



The bright colours of this *Etilingera* inflorescence show up well even in the dim light of the forest understory. This is an as-yet unidentified and potentially new taxon from near Sijunjung.



The pale lilac flowers of *Paraboea leuserensis*, an endemic to the Leuser region as its name suggests.



This beautiful succulent *Impatiens* was found on a vertical rock face in a sheltered spot near Sijunjung. This is a potentially new taxon, and is currently being researched by botanists at Herbarium Bogoriense.



The steep sides of the impressive Gunung Batu Kudo.



► The team at the end of the expedition to Simolap in Gunung Leuser National Park, photographed in front of a hot spring. From left to right: Four guides from Simolap village, Wisnu Ardi Handoyo, Carmen Puglisi, Mark Hughes and Ricky 'Bangkey' Igi.



► Limestone habitats are free-draining and can periodically become very dry. This plant of *Paraboaea leuserensis* has rolled up its leaves in response to water stress.



► Caves and sheltered crevices are important habitats in limestone areas; here, Wisnu is collecting a new species of *Begonia* near Simolap, North Sumatra.

perhaps 50-100 individuals within the cave, none were found outside, likely due to higher sun exposure and greater competition from other plants.

During our tour of what seemed like the entirety of the road network of West Sumatra, we stopped our vehicle to scramble up anything that looked like limestone. At one such locale, a cliff formed the biodiverse backdrop of a building site where a hotel will soon stand; one wonders if the new residents will notice they are looking out on a new species of *Begonia* we found there, with its tiny leaves pressed against the rocks.

*We did, however, find a striking *Impatiens* with globose orange flowers, and a brightly coloured *Etilingera*; upon consulting experts in these groups, it seems they are both likely to be new species, and are now the subjects of further research.*

Some of the most impressive outcrops of the expedition were seen near the Batang Sinamar River, such as those found along the steep sides of Gunung Batu Kudo. At the shaded base of this otherwise hot and dry peak, we found yet another new species of *Begonia*, with thick and succulent peltate leaves. Not far away are the peaks of the Sijunjung Regency, some of which we explored near the village of Solok Ambah. There, we managed to find two *Begonia* that actually had names, even though both have only been described in the past couple of years: *Begonia puspitae* and *B. droopiae*. We did, however, find a striking *Impatiens* with globose orange flowers, and a brightly coloured *Etilingera*; upon consulting experts in these groups, it seems they are both likely to be new species, and are now the subjects of further research.

The final leg of the expedition took us to Simolap, in the southern end of Gunung Leuser National Park, where low- to mid-altitude forest still exists extensively. We followed our guides through the reserve's many shady trails, some of which cut through the caves in the area. Here we found *Paraboaea leuserensis*, which is endemic to the reserve. All *Paraboaea* species that occur in Sumatra and the rest of the Malesian region are restricted to limestone, and most are able to cope with the drier and more exposed areas near the summits or bare faces of karst limestone. They have a distinctive felty mat of hairs on the undersides of their leaves, which may help to reduce water loss during dry periods. In the shadier, damper areas we found several new *Begonia* species, including one with rounded, dark leaves that are somewhat reminiscent of the related *Begonia rajah* from Peninsular Malaysia.

The remarkable number of new species found during this expedition reflects both the very high plant diversity of the karst limestone habitat in Sumatra, and our lack of knowledge about the island's unique limestone flora. The collections we made will go a small way in addressing this gap. Much work is to be done before we can fully understand the botanical treasures of Indonesia, knowledge which will be needed by the country if it is to balance conservation against development.

Mark Hughes

Royal Botanic Garden Edinburgh, UK/
SBG Research Associate

Deden Girmansyah

Herbarium Bogoriense, Indonesia

Wisnu Ardi Handoyo

Kebun Raya Bogor, Indonesia

Carmen Puglisi

Royal Botanic Garden Edinburgh, UK