BOTANICAL RECONNAISSANCE OF NUSA BARUNG AND BLAMBANGAN, SOUTH EAST JAVA

by

M. JACOBS

(Herbarium Bogoriense, Bogor)

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SUMMARY

Both Nusa Barung Island and Blambangan Peninsula consist of limestone hills; they are nowadays uninhabited and forest-clad. On Nusa Barung the forest is mixed and not conspicuously dominated by certain genera. On Blambangan the forest contains much bamboo, which points to ancient human influence, and a number of species characteristic for 'monsoon-forest'. A few remarks on history, and data about the author's routes, are given. Most of the plants collected are recorded in sketches of the vegetation. The f. *lobata* of *Gmelina elliptica* (Verben.) is reduced. Novelties are not reported, and it is doubtful whether the areas in question deserve much further attention for botanical exploration.

In the botanical knowledge of Java, though it is the best explored island in the Malaysian area, a few gaps are still to be filled. These botanically unexplored spots are mostly situated along the unfrequented and sparsely populated south coast which abounds in steep limestone hills and cliffs. For this reason I eagerly grasped the opportunity given to me to make a trip to Southeast Java with the objectives to explore the island of Nusa Barung and the peninsula of Blambangan, or Purwo. Both areas are situated in Java's most eastern Residency of Besuki and consist of Tertiary limestone hills which rise to about 200 to 300 m above the level of the surrounding Indian Ocean.

During the trip I tried to collect material of all species which were found either in a flowering or fruiting state; in a few exceptional cases where it seemed important for some reason or another sterile material was taken. The collecting work was shared by Nedi and Ukman, both of the Herbarium Bogoriense, who did excellent work. Special attention was given to trees and lianas; they were climbed or cut down whenever possible. We found very useful an apparatus that in French is called an 'ébrancheur': a kind of pruningshears, operated by a rope, on top of a bamboo with a lengthening-piece. Mr. Forman introduced this from Kew to Bogor; it rendered excellent service and may save the field botanist a lot of time, especially in savannahs and secondary forest.

In the following text my collecting numbers are cited in brackets. As many duplicates were collected as possible. The first set is at Bogor, the second at Leiden, the third at Kew, the fourth at Harvard, the fifth at Singapore, the sixth at Manila, and some are in other herbaria. The names adopted here are according to Backer's 'Beknopte Flora van Java'

(emergency edition), except in groups of which an adequate revision was available. The material collected was pre-identified by Nedi who, through his wide, keen knowledge of plants, was able to name also many species in the field. Those which were sterile or very common, here recorded without collector's number, are mainly named according to his suggestions.

Nusa Barung, visited on May 11, 12, and 13, 1957, yielded 77 numbers, of which n. 4718 is the first and n. 4795 the last. Then we went collecting on the south slope of Mt Raung and in the Baluran Game Reserve; both are not discussed here. Blambangan, visited on May 28, 29, 30, 31, and June 1, 1957, yielded 53 numbers, of which n. 4922 is the first and n. 4975 the last. June 2nd we returned taking 3 numbers on the way, and afterwards made a quick visit to the hills near G. Binda (see fig. 1), there taking 5 numbers. June 3rd we collected 8 numbers in the marshlands west of Kutoredjo, so that n. 4992 is the last number of the collection from this area.

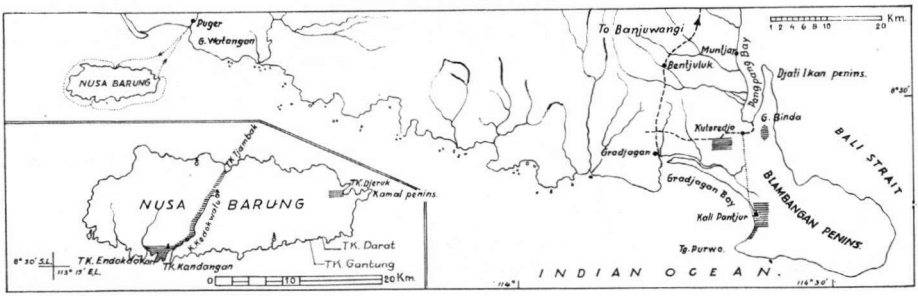

Fig. 1. Maps of Southeast Java and of Nusa Barung, showing the author's exploration. The surveyed areas are hatched; dotted lines indicate routes where no survey was made, viz by proa to Nusa Barung, and by truck, lorry and foot to Blambangan. Triangles indicate the approximate site of camps; the sign ♁ indicates springs on Nusa Barug. Tk. stands for teluk = bay; Tg. stands for tandjung = cape; G. stands for gunung = mountain. The large map is according to the 'Atlas van tropisch Nederland' (1938); the small one is according to HIND 1046, sheet 17, 2nd ed.

NUSA BARUNG

Introductory and historical notes

The island of Nusa Barung extends approximately from 8°26′ to 8°30′ S. lat. and from 113°16′ to 113°25′ E. long., its nearest distance from the coast of Java being 5 km, and twice as far from Puger a fishing village SW. of Djember. As its whitish cliffs rise almost perpendicularly from the foaming sea, the island is unapproachable except for a few shallow bays, recognizable from far by the yellow sand strip of their narrow beach, where a few fishermen sometimes pull up their outriggers while spending a night ashore. Otherwise the islet is a nature reserve, and uninhabited. There are reports (1), however, that in the 18th century there lived a population of a couple of thousand fishermen and smugglers who, in 1777, by force of the Dutch East Indian Company, were removed to Java, as

rioters had found protection with them. There seems to remain a curious point in this history, namely the question how so many people could maintain themselves in an island which, through its calcareous soil, is almost completely devoid of liquid water. In the centre of Nusa Barung a spring is found, Kedok Watu, but its yield is insignificant and game spoils the quality of the water. There must be a couple of other, coastal springs, and there are a few rocky river-beds, but most of the time these are dry *). In fact, lack of water is nowadays the limiting factor for every exploration of the island: water has to be taken from the shore at Puger, and the small proas cannot hold more than a three days' supply, while the establishment of a feeder-line is risky as weather conditions may suddenly turn bad and prevent a connection for days. The only way is thus to see in three days as much as possible, keeping the proas at the island.

Knowledge about Nusa Barung is very scarce. The first and only extensive publication about it is by the administrative officer P. C. Arends (15), who visited the island in November 1880. He landed at Teluk Djeruk and followed from there an almost overgrown track leading in a SW. direction to the cliffs Gantung and Darat, where small quantities of edible bird's-nests were being collected from caves in the rock. Apart from topographical particulars, he reported a small puddle of 15 m diameter with some water, two small patches of alang alang grass, many ferns (among which a tree fern) and 14 indigenous plant names. His conclusions concerning prospects for an eventual exploitation of the island were quite negative. In 1845 Zollinger paid two visits to the island, one of one day and one of two days, in January and February respectively. Records of his specimens are found scattered in his 'Systematisches Verzeichniss' and are cited in later revisions. Among the plants he collected it is worthwile to mention *Vernonia zollingerianoides* Sch.-Bip., known exclusively from Nusa Barung, where also Hoogerwerf found it, and from Puger. In 1880 Koorders visited Nusa Barung, on October 10; records of the plants he collected are mentioned in the 'Systematisches Verzeichniss' by Mrs Koorders—Schumacher. In 1913 A. J. Ultée made a one-day trip to the island; the few species he collected were identified by Backer (13). About 1916 Bremekamp visited the island for one day in the beginning of the dry season; he refers to the conspicuous yellow and red "autumn" colours of the deciduous trees (14). The specimens he collected are possibly preserved in the herbarium of the Sugarcane Ex-

*) That a numerous population could maintain itself, in spite of such dry conditions, is demonstrated on Nusa Penida, SE. of Bali. This island has quite the same structure as Nusa Barung; there is not a single river but only some springs near sea-level at the foot of steep cliffs. In a most interesting article, A. Gertis (2) described how on this island of 200 km² (Nusa Barung being 56 km²), 20 000 people keep alive (though no more than that) by bringing the water up the cliffs from these springs, with great pains and not without danger, and often carrying it over considerable distances. Besides, they hew big tanks in the rock for keeping the carefully caught rain water. At present Nusa Penida is completely deforested. We do not know how far former deforestation has proceeded on Nusa Barung, and it is arguable whether this could be stated now, after nearly two centuries; there are indications that this lapse of time is quite sufficient for the restoration of such a light forest as there occurs at present.

periment Station, Pasuruan. Hoogerwerf collected specimens during his exploration in July 1939, when he traversed the island from N. to S. coast. On December 3 of that year the Naturalists' Club at Djember made a sight-seeing excursion to Teluk Djeruk at the E. point. The participants Kooiman & Van der Veen wrote the third publication on Nusa Barung (3), but no botanical observations were made. In 1950 Rappard collected some plants on the dry coral rocks near Teluk Djeruk. His lowest collector's number seen by me is 173, his highest 226, the date is March 13, 1950. Apparently he was accompanied by Mochtarno, who also collected a few plants on the same locality on his own, dated March 11, 1950.

The number of specimens collected in Nusa Barung up till 1950 was estimated by Van Steenis (4) at about 200. Our own collections amount to 77 numbers.

After gaining local information, we planned the exploration as follows. We decided to start from Teluk Tjambak, in the middle of the north coast of the island, and the first day traverse to Teluk Kandangan on the south coast, where in the meantime the proas would have arrived via the West point of the island, and camp there. The second day would be spent in exploring a part of the southern coastal area, and after a second night of camping on the beach of Teluk Kandangan we would leave on the third day eastwards, round the Kamal peninsula, land at Teluk Djeruk, and after a short exploration there, return to Puger on the same day.

Course of the exploration

A thin mist over the clear ocean waters prevented sight of the island before we sailed close along its high rocky walls covered with a luxuriant vegetation of high trees and many lianas. The destructive action of the sea on the soft limestone had caused a typical mushroom shape in some of the rocks that formed the outposts of the land; Bremekamp has depicted one of these (14, fig. 1). *Desmodium umbellatum* (4723) was on them. On the shore we found a dense vegetation of trees of various size, many shrubs, herbs, and a few lianas; we noted *Ficus retusa, Uvaria littoralis* (4718), *Capparis pubiflora* (4719), *Thespesia populnea* (4722), and the white-flowering *Lasiobema scandens* var. *horsfieldii* (4720, 4721) with the typical cable-chain-like stems.

Now we had to find a dry stream-bed which was said to exist, to facilitate the ascent. We cut a path through a rather dense vegetation of a secondary character, dominated by *Kleinhovia hospita,* with many Euphorbiaceae, Leguminosae, and *Capparis pubiflora*; no rattans were seen. We collected *Pisonia aculeata* (4724), and indeed succeeded in finding a narrow stream bed full of big limestone blocks covered with a little moss, among which we were a bit surprised to see an *Amorphophallus variabilis.* We ascended slowly along the steep track, passed a fairly recent landslide and large trees of the i n g h a s, probably *Gluta renghas,* of cauliflorous *Dysoxylum* and *Ficus variegata,* and collected *Pisonia excelsa* (4727) which occurs here abundantly, while *Gendarussa vulgaris* and *Flagellaria indica* with saplings of the trees etc. form most of the undergrowth. At a few hundred feet the stream bed becomes shallower, while roots and lianas, e. g. *Desmos chinensis* (4729) creep over the

blocks. The soil is flatter here, scarcely over grown, and black with cracks as if periodically under water, where not covered with a thin layer of dead leaves.

After one and a half hour we reached the watershed. Here the forest canopy is not closed; the highest of the scattered trees are 25—30 m, while numerous thin lianas are present, from low to high, many shrubs, but very few ferns and epiphytes. Big patches of the soil are uncovered, and one has a clear view over a considerable distance. Except for the singing of birds and cicadas there is no sound.

Not far from the watershed we found a small area of springs among blackish soil full of hog foot prints. The dirty water in which a kind of shrimp is found, attracts many butterflies. In the neighbourhood is *Capparis lanceolaris,* a sprawling shrub but sterile, and again much *Pisonia excelsa.*

We now followed a new, wider river bed descending to the south; this was, except for some mud or stagnant water in remote places, dry again at one km from its origin. Soon scattered bamboo clumps appeared, some 4 m high, of a single species called b a m b u l a m p a r, *Schizostachyum zollingeri* (4731). Of the big trees may be mentioned *Eugenia*; k l u n t j i n g, *Spondias pinnata*; s a p e n, *Pometia tomentosa*; g l i n t u n g a n, prob. *Bischofia javanica*; and the medium-sized *Chydenanthus excelsus.* The forest remained poor and light. Epiphytes were scarce; we noted some *Taeniophyllums* and a *Drynaria.*

The level position of the strata that build up Nusa Barung can be observed not only from the sea in the cliffs, but also here in the centre of the island. The river has cut its way rather deeply through the limestone and, by subsequent erosion of the walls, a combination of horizontal and vertical structures have been formed so that the aspect recalls a town in ruins.

After six hours of going over the rough blocks, we saw the river-bed broadening and holding more water, and soon we reached a sandy creek turning into a minor estuary and a small sandy plain, sheltered by some masses of rock against the heavy ocean surf. Here we saw some *Rhizophora.* An exposed rocky wall more inland bore *Vanda limbata* (4735), *Ficus retusa* (4736), and *Polygala javana* (4737), the last two as kremnophytes.

The next day we penetrated westwards along the coast. Spurs of the limestone hills, one to two hundred feet high, directed to the south, resist here the ocean's power. Between these hill-spurs, green overgrown, small bays lie wonderfully embedded, mostly ending in a sandy creek that may be the mouth of another dry river-bed, and bordered inland by flattish areas. As may be deduced from the aspect of the soil and from the absence of herbaceous undergrowth, these areas are apparently inundated periodically. We found the vegetation different on the flat beaches, on the flat land beyond these, and on the hills. They will be briefly discussed.

The b e a c h, of yellow sand, is fringed by a *Barringtonia*-girdle in which here, however, *Barringtonia* was not seen. There were *Vitex negundo* (4747), *Terminalia, Cordia subcordata* (4748), *Aglaia elaeagnoides* (4738), *Mammea odorata* (4749), *Sophora tomentosa* (4750), *Guettarda speciosa*

(4751), *Parsonsia* cf. *spiralis* (4752), *Ochrosia ackeringae* (4753), and the herbs *Fimbristylis* cf. *cymosa* (4766), *Cyperus javanicus* (4768), *Euphorbia atoto* (4767), *Spinifex littoreus*, and *Ipomoea pes-caprae*.

Gradually the beach vegetation merges into a light forest on the flat hinterland. Closely behind the shore we found *Premna obtusifolia* (4762), a tree of 5 m high with a very wide crown full of ripe glossy black fruits, small trees of *Diospyros javanica* (4754), the shrubs *Capparis micracantha* (4757) and *Gelonium glomerulatum* (4755). There also were some *Alstonia* about 20 m high, *Chydenanthus excelsus*, and *Diospyros maritima*. Where the forest is poor, the last species can completely predominate, in company only with some lianas as Menispermaceae and *Tetrastigma* (fig. 2). Where the forest is richer, in the flat parts as well as on the flanks of the hills, it is intruded by such species as *Kleinhovia hospita* (4759), one of the commonest trees of Nusa Barung; *Eugenia sp.* (4741), a big tree, very common here also, but sterile (there may be other species too); *Sapium*; *Protium javanicum* (4743); a *Premna* (*obtusifolia* again?), a tree some 25—30 m high and almost completely bare; also smaller trees as *Casearia grewiaefolia* (4760), *Phaleria*, *Actephila javanica*, *Glycosmis pentaphylla* var. *citrifolia* (4742), the variety having simple and not 5-foliolate leaves, and the thorny shrub *Randia patula*. The soil remains poorly covered; one of the few species is the small *Pararuellia napifera* (4761), which may be rather abundant. We found scattered trunkless palms, perhaps *Corypha*, but these were too miserable for identification and adult specimens were not noticed. Epiphytes are present here and there on various big trees: *Asplenium nidus*, *Vittaria elongata* (4740), and *Aerides* sp. were seen.

The coastal hills of which we had to cross a number (fairly steep and without trails but the vegetation easily penetrable) are very dry. The stone they consist of has disintegrated into a blackish condition, but is pale yellow on fracture; it is layered quite horizontally as everywhere on Nusa Barung. Along the edges by the sea *Pandanus* (4771) abounds; *Allophyllus cobbe*, sterile now; the plump *Cycas rumphii*; and *Pemphis acidula* (4770). *Wedelia* and the tiny *Hemigraphis colorata* occur on the rock. As shown in fig. 3, the vegetation on top of one hill is an almost pure stand of *Croton tiglium* (4763), sterile now. Here and there are some *Buchanania arborescens* (4764), and *Bridelia stipularis* (4765). We went a couple of kilometres west, to Teluk Endokdokan, where the surf had hollowed out big niches in the rock, some of them 4—5 m deep; then returned to the camp for the second and last night on the island.

Early in the morning of the 13th of May our fleet of eight proas set out for Teluk Djeruk. After four hours we had rounded the Kamal peninsula, where the sea has eaten a tunnel through the isthmus (depicted by Kooiman & Van der Veen, l. c.), and had landed in Teluk Djeruk (also illustrated l. c.). This bay is the nearest to Puger, and is the most frequently visited. It is perfectly sheltered between high rocky hills.

In the shore fringe we met with *Terminalia catappa*, *Sophora*, *Hibiscus* cf.*tiliaceus* called the waru, *Sida acuta* (4772), *Vernonia patula* (4773), *Josephinia imperatricis* (4774), *Coccinia cordifolia* (4775), and at the base of the bordering hills *Hernandia peltata*, leafless but in flower,

Diospyros montana (4792), *Bridelia monoica* (4793), *Zizyphus oenoplia* (4794), and *Cissus nodosa* (4795).

Beyond the beach is a fairly broad, flattish, forested valley. Here is the only path we found on the island; after a mile in a western direction it disappears. Along this path we found an old grave, and a dry well of about 3 m deep with some *Diplazium* in it; more traces of human work were not observed. Arends (15) noted that the well was manufactured about 1865 on behalf of a Chinese who had rented the right of collecting the edible birds-nests. The forest is comparatively rich; it consists mostly of large *Artocarpus* cf. *elastica,* large *Terminalia,* and medium-sized *Kleinhovia hospita.* Numerous lianas occur, but few epiphytes. Of the less dominating big tree species we noted *Ficus nervosa* (4780), a *Spondias,* and *Mitrephora polypyrena* (4789).

Species of smaller size were *Chydenanthus excelsus* and again *Pisonia excelsa,* further *Saccopetalum horsfieldii* (4781), *Leea angulata* (4786) with on its trunk and branches six longitudinal rows of broad conical prickles, rather common about here; *Glycosmis pentaphylla* (4777), now with 5-foliolate leaves, *Sumbaviopsis albicans* (4782), *Ficus hispida, Alangium chinense* (4778), a treelet with horizontal branches, and *Garcinia dulcis* (4790), once seen only.

As stated above, lianas in various sizes were abundant: *Connarus* (4783) of 10 m, just in full flower, *Lasiobema* again, *Hippocratea indica* (4788) of 20—25 m, and large, prickly *Mezoneuron cucullatum,* with a trunk of 10—12 cm diam. Some palms were represented here: we observed a single *Daemonorops,* some other rattan (*Calamus*?) where the valley gradually gave way to a dry river bed, and a small *Caryota.* In the undergrowth we noted some *Flagellaria indica,* a few specimens of *Pandanus* cf. *tectorius* about 1 m high; *Oplismenus* and *Gendarussa vulgaris* were almost the only herbs on the blackish soil. The author was informed by Mr. Hoogerwerf that some old *Tectona* trees might occur here, but nothing of the kind was noticed.

BLAMBANGAN PENINSULA

Introductory

The peninsula of Blambangan or Purwo is the most southeastern part of Java, extending approximately from 8°37'30" to 8°47' S. lat. and from 114°21' to 114°36' E. long.; it is about 30 km long and 15 km broad; its surface about 400 km². Blambangan belongs geologically to the 'Gunung Kidul', a low calcareous mountain chain SE. of Djokjakarta, and is (as far as we could observe) very similar in structure to Nusa Barung; it consists mainly of limestone hills to an elevation also of some three hundred metres. However, here the limestone layers were noticed to rest upon a base of sandstone conglomerate (fig. 4). The hilly core of the peninsula is bordered by a more or less continuous, flat zone of mostly some 1—3 km broad, not far above sea-level. Its vegetation does not seem essentially different from that on the hills. The hills are often steep and irregularly disintegrated; the soil is shallow. There seems to be slightly

Fig. 2. Nusa Barung. Forest on flat limestone soil, chiefly of *Diospyros maritima*. The big liana is a *Tetrastigma*.

Fig. 3. Nusa Barung. Open forest on top of a limestone hill at the south coast, consisting almost exclusively of *Croton tiglium*.

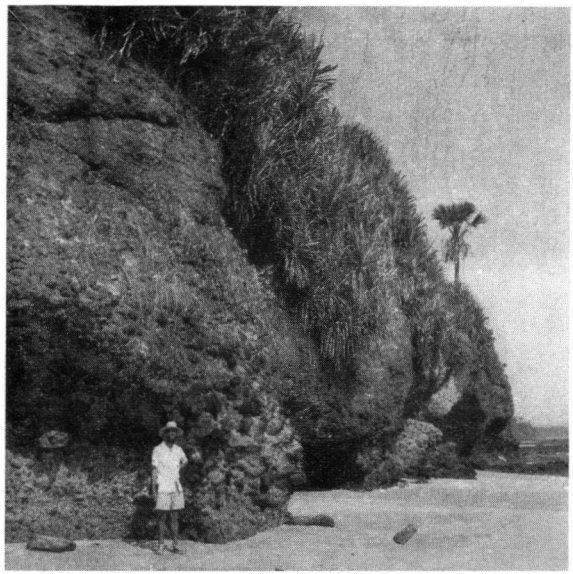

Fig. 4. Blambangan peninsula. Coast of Gradjagan Bay near Kali Pantjur. Below the limestone, the conglomerate is clearly visible. The rocks are overgrown with *Pandanus tectorius*, in the background right a *Corypha* palm.

Fig. 5. Blambangan peninsula. Bamboo vegetation. Background at right: b a m b u k e s i n g, *Bambusa blumeana*; at left: *Arytera* (Sapind.); centre: young *Corypha* palms; front: Zingiberaceae, among these a prostrate thorny bamboo stem.

more water available than on Nusa Barung: we crossed several small brooklets debouching on the beach.

The beach of Gradjagan Bay is not very agreeable to walk on. It consists mainly of globular sand grains about 2 mm in diameter, in which the foot sinks at every step. Moreover, when the tide is high, the beach becomes extremely narrow, and repeatedly we had to flee into the *Barringtonia* formation (genuine *Barringtonia* abounds here) to escape from unexpected waves.

The isthmus of the peninsula is flattish in the W. part, and covered with secundary forests; elsewhere there is probably a more or less primary forest. The eastern part is a northward continuation of the limestone massif of the peninsula proper; the ultimate spur of this is the ridge of a long and narrow peninsula not named on maps, but called 'Djati Ikan' by the population.

The whole area, declared to be a nature reserve in 1920, is under management of the Forestry Service which has considerable teak forests in exploitation in the SE. corner of Besuki; Bentjuluk is the main centre of this, with big stocks of timber which is carried there by trucks and lorries. By the Forestry Service several narrow gauge lines have been laid out, one of these running from a point between Bentjuluk and Gradjagan in an eastward direction. Through flat, lonely country the rails run to Kutoredjo, and from there curve northwards to Pangpang Bay. From Kutoredjo, a handful of houses round a shed of the Forestry Service, a jeep road was made almost right down to the south before the war. Of this former road no more than a narrow path has remained, obstructed by trees felled by a typhoon in December, 1956. This path goes on and on, until, after nearly ten miles of high bushes and forest, it suddenly ends on the wide beach of Gradjagan Bay. The path is used regularly by rattan and bamboo thieves who, however, do not penetrate far into the peninsula and seem to do no great harm to the vegetation.

The Forestry Service itself has left the peninsula undisturbed. A simple wooden lodging-house named 'Kali Pantjur' has been erected just behind the beach on a low hill, where a rivulet provides excellent water. Kali Pantjur is reached by walking another 3 km southwards over the beach. We were kindly permitted to use this as our bivouac.

Historical

The peninsula owes its name to the ancient Hindu kingdom of B(a)lambangan or Balemboang, that after c. 940 A. D. extended over the bigger part of Besuki and Probolinggo. In 1639, after a war of two years, it was subjugated by the sultan of the kingdom Mataram, and in order to prevent Balinese princes from establishing their influence there in Java, the population of Blambangan was led away in slavery to Mataram. In 1697 the Balinese invaded Blambangan and made it a colony. In 1767 the Dutch East Indian Company conquered Blambangan except for the surroundings of Gradjagan. In 1778 Dutch power was definitely settled (5, 6). We do not know how far the peninsula proper has been populated in past times. We found no traces of former civilization, but the abundance of bamboo in the forest everywhere we explored, indicates an influence of

man in the past. Recent human influence on the vegetation seems to be negligible; theft of some rattan and bamboo apparently has not effected radical changes, and we saw no traces of wood cutting, not even of the valuable teak.

The history of the botanical exploration of the peninsula is not very well known, but in any case it has been very scanty. According to Mrs Van Steenis—Kruseman (7) L. A. Deschamps must have visited it for six weeks in 1796, but the plants collected are apparently lost. Horsfield might have been there in 1806 *) and perhaps Koorders at the beginning of this century. In 1927 Posthumus & Backer were around for 2 days. The record of a visit by Du Rietz & Backer in the same year must either point to another Blambangan on the Ardjuno volcano complex W. of Malang, or be erroneous. After the war, Bloembergen, and later on, Forman, were at Kali Pantjur, but did not collect material. Botanical publications concerning Blambangan certainly do not exist.

Scheme of the explorations

Our journey was started at Banjuwangi, in the morning of May 27. By truck we were transported, via Bentjuluk, to the point where the lorry track crosses the road to Gradjagan. There the party and the luggage were loaded into a kind of toy railway carriage, and a big Caterpillar Diesel locomotive pulled it during an hour through teak forests, jungle and marshlands to Kutoredjo, where half a dozen carriers were already waiting for the luggage. Without losing time we marched off along the forest path, and at twilight the vanguard reached Kali Pantjur. On the next day we began our exploration in the vicinity of the bivouac.

It is difficult to penetrate deeply into the peninsula. A few paths radiating from Kali Pantjur in directions between NE. and SE. peter out at the base of the hills which rise abruptly from the flattish bordering zone between the hills and the beach. It was not possible to follow any long, accessible valley inland, since such valleys apparently do not exist. So every day a couple of men were sent to clear a track for the next day's trip. Such a track had necessarily to be made up hill, a tough job as for the ascent not rarely both hands and legs were needed. Thus we did not come further than the top of three hills near the coast, at most c. 6 km from the coast, and what, from there, we could see more inland, did not raise any expectations for obtaining many novelties.

We carried out explorations within a radius of 3—5 km between NE. and SE. of Kali Pantjur, on May 28, 29, and 30. On May 31 we went a few km to the south, chiefly along the sea shore. On June 1 we explored again at approximately 4—6 km NE. of Kali Pantjur.

Some remarks on the flora and vegetation

As stated above, the structure of the vegetation in the flat marginal zone seemed essentially similar to that in the hills. Of course a number

*) In the narrative of his travels (Trans. Batav. Soc. Arts & Sci. VII, 4: 17 seqq. 1814) he uses the name Blambangan for the whole eastern part of the present Res. Besuki. There is no indication that he visited the peninsula proper.

of species avoid the seashore. In the hills, bamboos seem to be less abundant, whereas there is a somewhat better developed undergrowth of herbs and low shrubs, both being almost absent from the flat land. But as far as could be concluded from our superficial observations, there is no reason to treat here the flora of the hills and the flat borderlands apart. We noted, however, that the rock protruding on to the beach next to Kali Pantjur had a somewhat different flora; this will be recorded with the results of our trip along the coast south of Kali Pantjur. As appears from the figures given above the harvest was very poor. As various trees were still in bud at the time of our visit, or in the very beginning of blossoming, it would perhaps be advisable to make a future collection a fortnight later, about June 15.

A. *Behind Kali Pantjur inland*

The canopy of the forest is irregularly broken up, the biggest trees (e. g. *Ficus, Sterculia, Terminalia, Lagerstroemia, Tetrameles, Eugenia, Tectona*) attain some 25—30 m, and the lower trees mostly stand intermingled with bamboos (fig. 5—6). The bamboos occur in vast quantity, but do not form pure stands of any size. We noted four species, which the local people could easily distinguish and which had fixed vernacular names.

The species are:

B a m b u w u l u h — *Schizostachyum blumei* (4943), a bamboo about 5 m high.

B a m b u m a n g g o n g — *Gigantochloa verticillata* (4944), 10—12 m high.

B a m b u d j a d j a n g — *Gigantochloa apus* (4956), about 10 m high, and in full flower.

B a m b u k e s i n g — *Bambusa spinosa* (4975), about 18 m high; the whole clump is surrounded by prostrate, thorny stems.

The given vernacular names, though perhaps only of local value, are more reliable than the scientific names. These are taken from Backer's work (8), but the first three of his species cited seem to represent mixtures of two or even more species; besides, the correct name of *B. spinosa,* being a later homonym, is *B. blumeana.* Backer states that both species of *Gigantochloa* are allochthonous in Java and thus must have been introduced by man.

It is particularly the abundance of bamboos (whether planted purposely or not) that makes ancient human influence probable. When in not too dry a climate a primary forest is depleted, bamboos possess an advantage over the other components of the forest that can hardly be annihilated if conditions are dry enough.

According the opinion of Reiling (9), quoted with approval by Van Steenis (10), a bamboo forest proper contains 10—40 %, at most 50 %, of original forest elements. Considering this, the forests explored by us at Blambangan peninsula may be classified rather as poor primary forest with a great percentage of bamboo (estimated 20—40 %), and some teak. Since bamboo does not occupy big closed areas in which no more forest

trees seem able to settle, it seems probable that this forest was never destroyed totally, but depleted for a minor part.

Where bamboos do not occur, often rattans (3 spp.) are found. Other lianas, often large ones, also take an important part in the vegetation. In most places the forest is not too difficult to traverse (fig. 5), as undergrowth is mostly poor, especially in the flat lands, and contains, apart from some shrubs, several monocots as *Pleomele, Marantaceae, Zingiberaceae, Flagellaria,* and once a big *Musa (zebrina?)*.

Though the forests in West Blambangan contain numerous species that are, according to Van Steenis (l. c.), typical for a so-called monsoon forest (i. e. a forest in which 50—90 % of the trees are deciduous), the aspect of the vegetation is not much that of a monsoon forest as we found it N. of Banjuwangi. In certain places a mixture of *Tectona* and *Lagerstroemia,* often with much *Ficus* in it, is predominating; however, trees with umbel-shaped crowns are not present, nor is there much thorny brushwood, and enough rattan occurs. Considering Van Steenis's list of species typical for a monsoon forest, it can be stated that

present are:

Albizzia (very scarce),
Cassia fistula,
Caesalpinia digyna,
Derris sp.,
Desmodium sp.,
Kleinhovia hospita,
Lagerstroemia speciosa,
Schleichera trijuga,
Spondias pinnata,
Sterculia foetida,
Tectona grandis,
Tetrameles nudiflora,
Vitex pinnata (= *V. pubescens,* but as this widely distributed species was also found e. g. in marshy forest at Bengkalis, at Malacca Straits, it seems doubtful whether this can be regarded as typical for a monsoon forest);

absent are:

Acacias,
Actinophora (= *Schoutenia*),
Albizzias (most representatives),
Butea,
Dichrostachys,
Dillenia (by "*D. aurea*" obviously *D. pentagyna* is intended),
Flemingia,
Gossampinus (= *Eriodendron*),
Homalium,
Phyllanthus emblica,
Zizyphus.

Apparently the forests in question represent one of the many transitional stages between genuine deciduous and genuine evergreen rain-forest. Elements typical for secondary forests seem remarkably scarce.

The following list contains the names of the species collected (provided with the author's collecting number), and of the species noticed but not collected.

a. Trees over 10 m high, in all 34 species:

Aglaia sp.
Alstonia sp.
Arenga saccharifera.

Artocarpus cf. *elastica.*
Buchanania arborescens (4929, 4934); common.
Canarium hirsutum var. *hirsutum* (4928); a rather small tree, in the flat lands.
Carallia brachiata (4772); a slender tree, in the hills, rare.
Cassia fistula.
Celtis cf. *wightii.*
Chydenanthus excelsus; in the hills.
Corypha cf. *utan*; rather frequently scattered, from the shore to in the hills, with many youngsters.
Diospyros buxifolia.
Diospyros maritima.
Dysoxylum sp.
Eugenia, more spp.; frequent.
Ficus benjamina, and probably other stranglers.
Ficus hispida.
Ficus variegata.
Lagerstroemia speciosa (4946); abundant, now in fruit.
Lindera gemmiflora (4957) — by Kostermans transferred to *Beilschmiedia*; rare.
Lophopetalum sp.; big tree.
Palaquium javense (4961); on hill, rare.
Parinari sp.
Parkia sp.; in the hills.
Plectronia sp.
Pometia sp.
Pterospermum javanicum (4960); frequent.
Sarcocephalus sp.
Siphonodon celastrineus (4974); on hill, rare, wood very hard.
Spondias pinnata; common big tree.
Sterculia foetida; some of the specimens bare and flowering, a rather common, big tree.
Tectona grandis; abundantly scattered.
Terminalia, perhaps more spp.; common big trees.
Terminalia microcarpa (4954); a small tree.
Tetrameles nudiflora; a few times seen, big tree.
Vitex pinnata (4926); common tree, rather small.

b. Trees below 10 m and shrubs, totalling 19 spp.:

Capparis micracantha; scattered in the hills.
Caryota sp.; small palm, not frequent.
Citrus sp.; once seen.
Clerodendron speciosissimum (4969); bright red-flowering.
Diospyros buxifolia.
Evodia latifolia (4922).
Ficus sp. (4933); a cauliflorous treelet.
Gelonium sp.
Glycosmis pentaphylla var. *citrifolia*; scattered.
Gmelina elliptica (4923), — the shrub produces peculiar suckers, one of which was secured. A comparison with material identified by Moldenke showed that the normal twigs were identical with *G. elliptica*, but that the sucker was identical with *G. elliptica* f. *lobata* (Gaertn.) Moldenke, Phytologia 4 (1953) 178. To make things quite certain, living shrubs in the Hortus Bogoriensis were examined, where the species is cultivated as *G. asiatica* L. var. *villosa*, under the numbers XV F 6, 7, and 19. It appeared that the upper twigs are thornless, with entire, long-petioled leaves, whereas the suckers and their branches in the lower part of the plant have vigorous thorns and smaller, lobate, short-petioled leaves. The two are so different in habit indeed, that a herbarium taxonomist could put them into two taxa.
Leea angulata (4939); a small tree, with prickly trunk and branches, frequent, especially in the flat lands.
Licuala sp. (4938), djambi sawit; a tufted palm 3 m high, on moister places.
Mallotus philippinensis.

Orophea enneandra (4959).
Pipturus argenteus var. *incanus* (4970); on top of a hill.
Phyllochlamys sp.; on hill.
Pleomele elliptica (4931, 4941); thin shrub 3—4 m, in flower and fruit, not rare.
Psychotria sp.
Saprosma fruticosum (4971); a low shrublet with bright blue fruits.
Xanthophyllum sp.

c. Climbers of various size, totalling 25 spp.:

Amepelocissus arachnoidea (4955); about 15 m long, the fruits become blackish and rather delicious.
Anamyrta cocculus (4952); a small liana, only a male specimen found.
Artabotrys sp.
Bauhinia pottsii var. *elongata* (4950); about 10 m, locally frequent.
Caesalpinia digyna (4924); about 10 m.
Calamus sp. (4922), rotan tjetjeret; a graceful, very common rattan, flowers scenting heavily and disagreeably sweetish.
Calamus sp., rotan legi.
Combretum cf. *punctatum.*
Connarus sp.
Daemonorops sp., rotan sepat; sturdy, scattered.
Derris sp. (4940); could not be identified sterile; the roots are used for poisoning fish.
Ficus obtusa (4958); a big liana with many stems of 10 cm.
Gnetum gnemon; scattered.
Jasminum sp.
Lasiobema scandens var. *horsfieldii*; in big specimens with the typical chain-like stems.
Lepistemon binectariferum (4973).
Marsdenia? sp. (4932).
Merremia peltata (4953); flowers bright yellow.
Mucuna acuminata (4949); climber of several metres, flowers greenish violet and white.
Olax scandens (4937); a big liana.
Polyalthia sp.
Smilax sp.
Tetracera scandens (4947); big liana, now in fruit.
Tetrastigma sp.; rather frequent.
Uvaria littoralis (4948); a big liana, with *Tetracera* in the flat area.

d. Herbs, terrestrial and epiphytic, belonging to 14 genera:

Araceae; a few climbers.
Asplenium nidus; here and there.
Cassytha filiformis; a small bit was found at 1 km from the sea.
Donax cannaeformis (4935); some 2 m high, on hill.
Drynaria sp.; here and there.
Flagellaria indica; rare, on hill.
Lepidagathis sp.
Leptaspis banksii (4936); a very attractive grass with red fruits, locally in the hills.
Lindsaya sp.; scarce on shady slopes.
Musa sp. (*zebrina?*); one plant only seen.
Oplismenus compositus.
Piperaceae; a few climbers.
Pseuderanthemum sp.
Phrynium repens (4977a); c. 40 cm high. The specimen is in fruit only and was taken because of its abundance, especially in the flat lands.
Stenochlaena palustris; a creeping fern, rare.
Taeniophyllum filiforme (4925); not infrequent on tree boles.
Zingiberaceae; some species, rather abundant.

B. The coastal area

On May 30 we investigated the cliff depicted partly in fig. 4, which, breaking through the flat marginal area, is a landmark on the flat beach of the Gradjagan Bay, just near Kali Pantjur. On the steep wall itself occur, below a fringe of pandans, some grass and (probably) *Desmodium umbellatum*. To the pandan belt, which is a few yards broad, seem confined *Cassia timorensis, Morinda citrifolia,* and *Erythrina*. The photograph shows the occurrence of *Corypha* cf. *utan,* and young plants of this are present in the thin vegetation on top of the cliff. There is b a m b u k e s i n g again and r o t a n t j e t j e r e t, further *Alstonia sp., Flagellaria indica, Hibiscus tiliaceus, Casearia sp., Cordia subcordata, Salacia sp., Capparis micracantha, Drypetes sp., Cudrania spinosa.* We observed some *Lantana* (the only one we saw on the peninsula proper), and on the sparsely covered soil a few *Urena lobata* and much of a low grass, not identified.

As stated already, *Cassytha filiformis* was seen only about 1 km inland from here.

We received the impression of a diluted mixture of the floras typical for the sandy beach and for the interior of the peninsula.

On May 31 we made a laborious march along the beach, in a southern direction. The *Barringtonia*-fringe is dominated by *B. asiatica* and *Scaevola sericea*; also *Terminalia catappa, Hernandia peltata, Mallotus sp., Cycas rumphii, Sophora tomentosa, Guettarda speciosa, Pandanus, Pongamia pinnata, Xylocarpus moluccensis, Pleomele angustifolia, Ipomoea pes-caprae, Phaseolus sp., Crinum asiaticum* are here. The formation is often interrupted by creeks of stagnant water, swept in by the sea at high floods across the strandwall.

At about 4—5 km S of Kali Pantjur low limestone rocks occur on the beach. On these rocks *Salsola kali* was seen *). Here, near a primitive hut on poles, we collected material from a group of *Manilkara kauki* (4962), of *Hoya* cf. *diversifolia* (4963), hanging down from some 10 m height, frequent along this shore, and of *Colubrina asiatica* (4964). Then we proceeded inland, to about half a kilometre. Here the forest is low and the trees are thin, the soil is dark greyish and poorly overgrown. We noted *Sterculia cordata* (4965), *Albizzia sp., Spondias pinnata,* a good *Diospyros buxifolia, Vitex,* much of *Artocarpus,* some strangling *Ficuses, Syzygium syzygioides* (Eugenia cymosa) (4965), and *Gnetum gnemon* var. *gnemon* (4966). The latter made a tree of 12 m by 25 cm. Markgraf (11) denies that it is indigenous in Java, Koorders & Valeton (12) mention it from old secondary forests near Rogodjampi, on the site of the former capital of the kingdom Blambangan; it might have been introduced here also, but we did not notice other cultigens. Shrubs and lianas were rather well represented, such as *Drypetes, Micromelum minutum* (4968), *Murraya, Glycosmis, Capparis micracantha.* The growth of epiphytes is comparatively rich: we saw *Dendrobium, Asplenium nidus,* and *Drynaria,* and a thin layer of moss on some of the trunks.

*) Unfortunately we did not secure material, so that no proof for my suggestion is available. Judging from the Flora Malesiana (I, 4: 106) it would be the first record from Java.

Fig 6. Blambangan peninsula. Vegetation as seen from the top of a hill near the coast. Left: bambu kesing, *Bambusa blumeana*; centre: a *Corypha* palm with a *Pterospermum* tree in the depth right of it; right: a big *Ficus variegata*. Foreground: *Bauhinia pottsii* var. *elongata*, intermingled with Zingiberaceae.

C. East and West of Kutoredjo

On June 2 we went eastwards from Kutoredjo to get an impression of the northern spur of the Balambangan limestone plateau. Between the lorry track and this narrow ridge of hills, one of which is called Gunung Binda, mainly secondary forest is found. The forest on the hills proper looked essentially similar to that on the peninsula near Kali Pantjur, but poorer and with some secondary elements. We saw that much damage had been brought about by the hurricane half a year previously. We noted such trees as *Spondias, Buchanania, Lophopetalum, Ficus callophylla* (4981), *Syzygium syzygioides, Pterospermum javanicum, Cleistanthus, Ehretia laevis* (4979), *Grewia microcos* (4982), *Phyllochlamys taxoides, Memecylon monchyanum* (4980), *Beilschmiedia.* There was some b a m b u k e s i n g again, some *Lantana, Claoxylon, Plectronia, Lasiobema scandens* var. *horsfieldii,* and on clearings caused by the storm *Melothria perpusilla* (4983).

A visit to the 'tegalan' west of Kutoredjo, on June 3, may be briefly mentioned. The country there is flat, and the aspect of the soil betrays periodical inundation. It is pastured regularly. A good deal of the vegetation consists of *Cyperus compactus* (4984) and of *Paspalum longifolium* (4985). *Imperata cylindrica,* the a l a n g a l a n g, *Hydrolea zeylanica, Alysicarpus bupleurifolius* (4987), *Phyllanthus virgatus* (4988), *Phaseolus sublobatus* (4989, 4992) with its typical asymmetrical flowers, *Uraria picta* (4990), and *Abutilon sp.* (4991) are less abundant herbs. The amaranthaceous *Alternanthera sessilis* is found beside the dry puddles here and there. Shrubs and trees are sparse and scattered: *Antidesma ghaesembilla, Flemingia, Zizyphus, Erythrina,* some young *Dillenia pentagyna, Sarcocephalus,* and some larger *Cordia* cf. *monoica.* But it is the few lonely *Corypha* palms, tormented by the steadily blowing dry east monsoon, that dominate the country, stressing its dismal, even ghostly, emptiness.

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