X. BRIEF HISTORY OF THE BOTANICAL EXPLORATION IN THE GUNUNG LEUSER NATURAL PARK AND VICINITY, NORTH SUMATRA

With itineraries and reports of the exploration tours by Van Steenis (1937) and De Wilde & Duyfjes (1972–1991)

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SUMMARY

A concise history of the botanical collecting and abbreviated reports of the exploration tours by C.G.G.J. van Steenis and De Wilde & Duyfjes in the Gunung Leuser Park and vicinity, northern Sumatra (mainly Aceh Province) is given. This shows that essential areas of the Park, e.g. at the West side, are still botanically unknown. The remarkable achievements in field work by Van Steenis are recorded. The detailed descriptions of the itineraries give a good impression of the constitution and botanical conditions of the terrains of the interior and will be useful for the logistics of future exploration efforts in this difficult and unsurveyable area. The amount of botanical collecting done in the various vegetation types traversed is indicated. The accounts should be consulted in conjunction with the outline on the vegetation of the Park as is also presented by the authors in the Leuser Book (C. van Schaik et al., in prep.).

INTRODUCTION

The Gunung Leuser Park with a surface area of some 10,000 km^2 (Van Strien, 1978) is among the largest tropical rain forest nature reserves in Indonesia, and a refuge for several very rare species of large animals menaced with extinction, e.g. Orang Utan, Sumatran Rhinoceros, Elephant, and Tiger. These animals are highly dependent on lowland- and lower montane forests of large extensions. However, also in the Leuser Park, such forest is relatively little represented, presumably only for some 5 or 10 percent of the park surface, mainly in its fringes (Fig. 1).

With the animals, the vegetation composed of a large variety of plant species also finds refuge in this area, though severely menaced by human encroachments of all sorts. It needs no saying that botanical knowledge of the area is crucial for conservation management. Therefore, from 1972 onwards with various intervals we have made a botanical inventory of the area. A gross outline of the vegetation of the Leuser Park will be published before long in the Leuser Book (scheduled for 1994) and a brief essay on the high-mountain blang vegetation in the Proceedings of the Second Flora Malesiana Symposium (De Wilde, scheduled for 1994).

As a matter of fact, the botanical knowledge of such a vast area, extremely rugged and with various high mountains to over three thousand metres high (Fig. 2, Photograph 1), will remain deficient for a long period to come, as its floristics can only be known by means of a thorough inventory by collecting and critical identification of specimens. Therefore, it appeared that with the present state of exploration and knowledge the preparation of a botanical check-list for the area is still premature, and, moreover, an almost endless task. As an aid getting an insight in the actual plant-cover of the interior of the Park we endeavour in

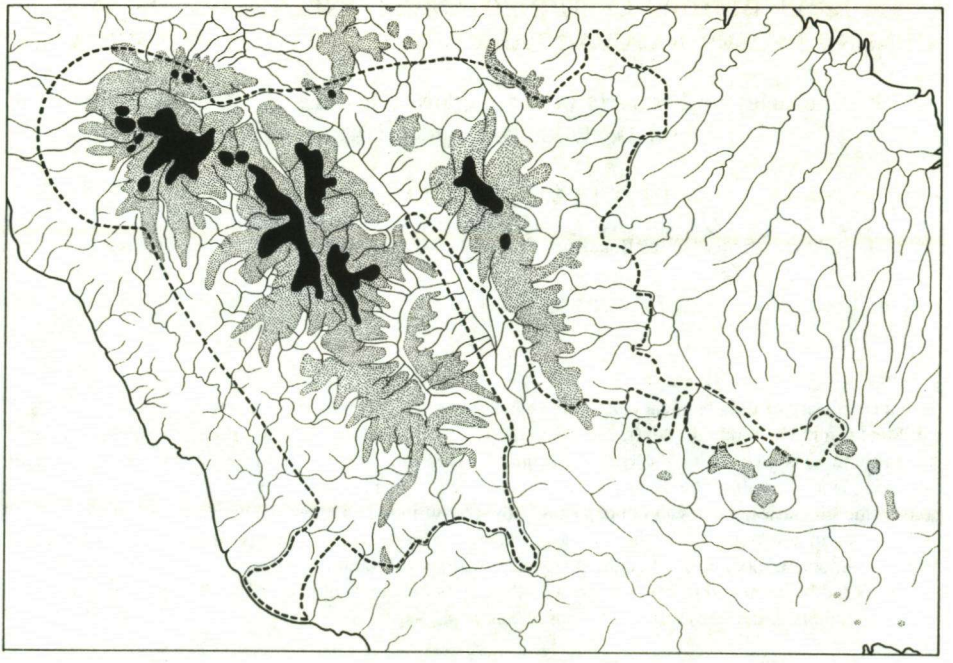


Fig. 1. A part of northern Sumatra with the approximate boundaries of the Leuser Park with the courses of the rivers and roughly the contour-lines of 1500 and 2500 m indicating the proportions of lowland and submontane forest (white), high-mountainous forest (stippled), and subalpine forest and scrub area (solid black) within the Park. — Simplified after a text figure in 'Management Plan for Gunung Leuser' by Van Strien (1978).

this article to present an abbreviated report of the botanical explorations by Van Steenis (1938) and by the authors in 1972, 1975, 1979, 1985, and 1991. These tours, mostly with the purpose of reaching the top areas of the high mountains, actually provided for deep intrusions into the interior of the Park, by which most of its vegetation types were traversed (Fig. 3). We believe that the description of the itineraries, including the daily description of the sometimes monotonous vegetation, and a mentioning of noteworthy plant species encountered, gives a good impression of the vegetation, thus essentially complementing the more static formal descriptions as presented in the Leuser Book.

BRIEF HISTORY OF THE BOTANICAL EXPLORATION AND INVENTORY OF THE LEUSER AREA

The number of plant collectors who worked actually in or in the vicinity of the Leuser Park is quite restricted. For the whole northern part of Sumatra (Aceh, Prov. of N Sumatra, northern East Coast Prov., northern Tapanuli), however, the list of persons who collected at least some specimens is surprisingly long. For the period before c. 1950 it amounts to over 170 collectors, with in addition more than 110 names of people who collected in the bb-series for the Forestry Research Institute, Buitenzorg (now Bogor) (BZF); for the period after

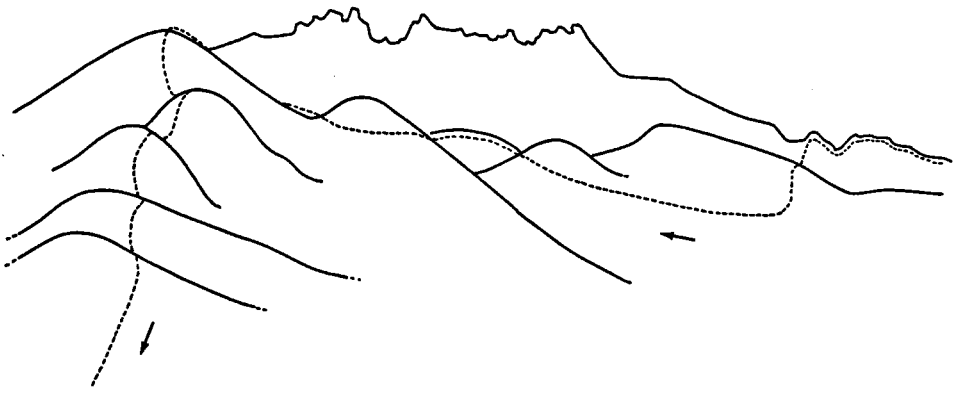


Fig. 2. The contours of the rugged limestone mountain ridge Gunung Ketambe as seen from a ridge to the SW (at c. 2700 m) drawn from photographs and sketches in the field book; Mt Ketambe reaches c. 2400 m and possibly is the only location of the singular endemic *Monophyllaea wildeana*. The stippled line indicates the expedition itinerary.

c. 1950 we counted more than 100 collectors, including 6 names in the bb-series (most information taken from Van Steenis-Kruseman, 1950, 1958, 1974). The botany of the whole of northern Sumatra is, of course, highly relevant for the assessment of the botanical knowledge and value of the Park, also because many collections have been made in areas adjacent to the present Park in vegetations which are by now largely destroyed.

Together with the chronological enumeration of the most important collectors in or close to the area of the present Leuser Park, concise itineraries and short reviews of the results are given. By far the most important explorations and botanical collections have been made by Van Steenis in 1937 and De Wilde & Duyfjes in 1972 and later. The latter are treated in some more detail. The various sorts of vegetations passed through are mentioned, thus providing some information on the state and conditions of the vegetation in the areas visited.

CHRONOLOGICAL LIST OF COLLECTORS AND THEIR ACTIVITIES

1904 — PRINGGO ATMODJO, assistant at the herbarium Bogoriense (BO) attended the punitive expedition under Lieutenant-Colonel G.C.E. VAN DAALEN through the Gayo and Alas Lands (Aceh and North Sumatra). He collected 544 numbers of well-preserved material. The expedition, largely on foot, lasted from January to August, started at Lhok Sumawe and passed along Laut Tawar and through many villages, finally following the Renun River and ending at Lake Toba. The main collection set is at BO, duplicates are in L. From this collection *Sonerila daalenii* was described.

1914–1925 — J.H. LÖRZING (1872–1945; German) was sent in 1914 from Buitenzorg to North Sumatra to found the botanical garden at Sibolangit (above Medan) in 1915 as an annex to the Buitenzorg garden. During his stay in the area, from Sept. 1914 till 1925,

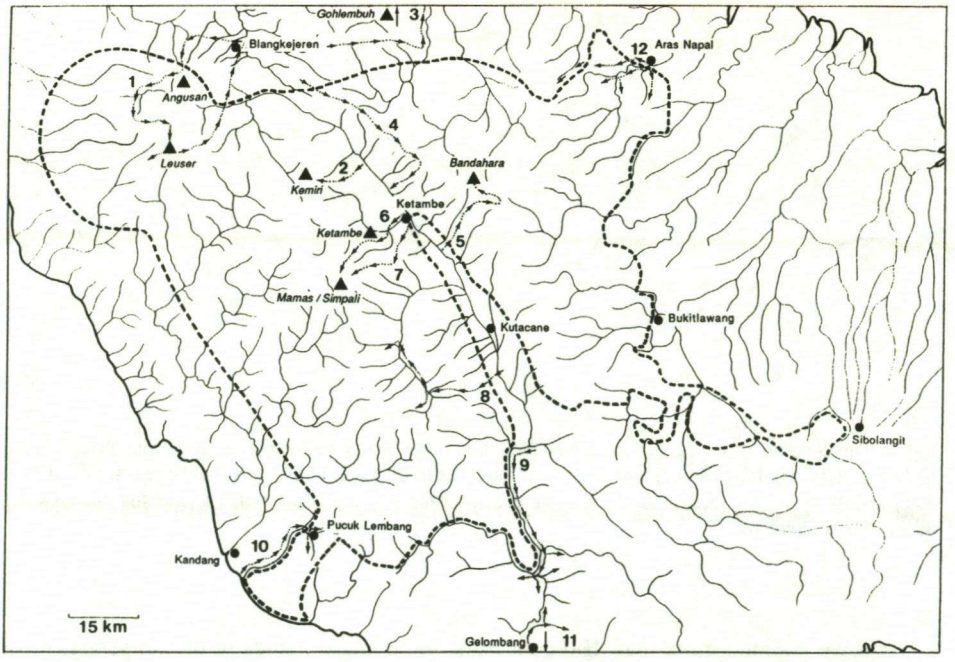


Fig. 3. Localities and approximate itineraries of botanical exploration tours in the Leuser Park and vicinity. The map shows a portion of northern Sumatra with the courses of the rivers, the approximate boundaries of the Park, some relevant place names (dots), most of the high mountains (or mountain complexes) of the area (triangles), and the following travel routes: **1.** climbing Mt Leuser (c. 3450 m) via Mt Pucuk Angasan (c. 2700 m) by Van Steenis 1937 and De Wilde 1975; **2.** climbing Mt Kemiri (c. 3300 m) by Van Steenis 1937, Iwatsuki c.s. 1971; **3.** climbing Mt Gohlembuh (c. 3000 m) by Van Steenis 1937; **4.** tour in the Kappi area by Van Steenis 1937; **5.** climbing Mt Bandahara (c. 3000 m) by De Wilde 1972 & 1975; **6.** tour to Mt Ketambe (limestone, c. 2400 m) and back-lying high ridges (to c. 2800 m) by De Wilde 1972; **7.** tour towards Mt Mamas (Simpali complex, 3200–3300 m) by De Wilde 1975; **8.** tour to the upper Mamas River valley by De Wilde 1979; **9.** tour along the middle Alas River to Muara Bengkong and Muara Renun by De Wilde 1979; **10.** tour in the Lembang River area (Kluët Forest Reserve) by De Wilde 1985; **11.** route of the Lae Sauraya (middle Alas River) expedition by De Wilde 1985; **12.** exploration in the Sekundur Forest Reserve (base camp at Aras Napal) by De Wilde 1979, 1991. — Prepared on the basis of a river map by Van Strien (1978).

he collected approximately 8000 numbers (3001–11629) of which the numbers 10200–10999 were left blank; according to Van Steenis-Kruseman (1950, p. 327) there is a list at BO. His large private herbarium (later in Medan) was transferred to BO in 1950. In 1919 he employed the native collector GALOENGI. *Gentiana loerzingii* from the Karo highlands (no material in L), and the genus *Loerzingia* were described from his collections. Lörzing collected mainly around Sibolangit, on the Karo plateau near Lake Toba, on Mt Sibayak, etc.; collecting localities listed by Van Steenis-Kruseman (1950, portr.). See Lörzing (1921); Bartlett (1935); Backer (1936).

1918 and onwards — H.H. BARTLETT and collaborators. Bartlett (American; since 1915 professor of botany at Michigan) was in 1918 in the employment of the U.S. Rubber

Co. at Kisaran, Asahan, East Coast of Sumatra, as a botanist. The collections from Asahan and the Karo Plateau of about 500 numbers were made by native collectors, i.e. GALOENGI and RAMAT (alias Bidin Sirait Holboeng) under the direction of C.D. LARUE (at the time also a botanist of the U.S. Rubber Company) and Bartlett. In 1926–1927 he made a collecting trip to Formosa (Taiwan) and North Sumatra under the joint auspices of the University of Michigan and the Smithsonian Institution. He arrived in Asahan on 25 December 1926. Operating from Silo Maradja fieldwork lasted from January to July 1927. For more details and literature references, see Van Steenis-Kruseman (1950, p. 38, portr.).

The **1927** collections amounted to some 2400 numbers (numbered above 6000) mainly made in Asahan and surroundings.

In **1928–1936** the native collector RAHMAT SI BOEEA (see there) made large collections in the Batak Lands (Tapanuli) and East Coast Residency, in the employ of BARTLETT and partly under the direction of the American Methodist missionary C. HAMEL. Rahmat was trained by Bartlett in 1927.

In his article 'The Batak Lands of North Sumatra from the standpoint of recent American botanical collections' BARTLETT (1935) described in detail his own collecting as well as contemporaneous work by the Dutch and especially that of RAHMAT SI BOEEA, the Americans H.S. YATES, B.A. KRUKOFF, the BANGHAMS (see there), and minor collections by some others (D. FAIRCHILD and others). Krukoff collected in 1931–1932 some 600 numbers in Asahan, largely within the same areas as previously investigated by Bartlett.

Most of the American collections were identified by E.D. MERRILL (1919, 1934a, b, 1935, 1937, 1938), who described several new species and the new endemic cucurbitaceous genus *Siraitia*, named after Si Rait (a name adopted by Bartlett as a tribal brother of the chieftain at Silo Maradja).

Bartlett also stressed the reputed differences in the floras in connection with the two main soil types prevalent in the area explored by him, viz. the acid liparitic tuff soil and the andesitic soil, the latter derived at least in part from basic andesites and to which successful tobacco culture is restricted. At the time he advocated that more investigations would be necessary to assess these floristic differences, a research that would be seriously hampered today because most of the original forest vegetation has been and is being destroyed.

Furthermore he gave data on the geology and a broad outline of the habitats found in the area: the coastal plain, with the culture belt, and the high plateau, the mountains, including brief discussions about the following habitats as were earlier identified by Yates: 1) the beach, 2) the mangrove belt, 3) the Nipa Swamps, 4) the swampy, white-soiled alluvial plain (with swamp forest), 5) the pematang (i.e. the local name for elevation or ridges) of the coastal plain, 6) the lower well-drained volcanic tuff region, 7) the high plateau, and 8) the mountains. The article ends with an index of botanical collecting localities.

1921 and onwards — FOREST RESEARCH INSTITUTE BUITENZORG (BZF; Bogor, founded in 1913); most collections were made in the bb-series. Numerous persons made minor collections in the area s.l., but none specifically in the area of the present Leuser Park. According to Van Steenis-Kruseman (1950, p. 177) the bb-collections taken together and specified for the various regions of Sumatra (up to 1950) are: Aceh 724 nos.; Tapanuli 1071 nos.; Sumatra West Coast 1671 nos. and Sumatra East Coast (incl. Siak and Bengkalis) 2155 nos. We estimate that for the Leuser area s.l. only about 2000 bb-numbers will be concerned. Employees of the Forest Research Institute who worked and traveled in the area and published various reports were LUYTJES (1923, 1924) and ENDERT (1925) but

apparently their actual collecting was limited, Endert gathering only 36 numbers during his inspecting tour through Aceh, Tapanuli, and Sumatra's W and E Coast Residencies in 1922.

1921, 1923–1927 — H.S. YATES was an American phytopathologist employed by the U.S. Rubber Company, at Bunuk, Asahan, and made nearly 2000 collections in the East Coast Residency and Tapanuli, both areas at present within North Sumatra Province. Together with those of Bartlett, Hamel, and Rahmat si Boeea his collections provided the material for several papers on mosses, ferns, and phanerogams by Merrill (1934a, b, 1935, 1937, 1938). Bartlett (1935) presented a detailed itinerary with localities and numbers, most specimens being from Asahan.

c. 1928–1936 — RAHMAT SI BOEEA; a skillful local plant collector in 1927 trained by Bartlett (1935), and since then in the employ of the latter, starting his work under supervision of the reverend C. HAMEL of the American Methodist mission. The collections have often been cited as made by Hamel and Rahmat si Toroes, or by Rahmat si Toroes only, but according to Bartlett (1935) his correct name is Rahmat si Boeea. Rahmat accumulated over 10,000 numbers mainly from the Batak Lands (Tapanuli) and the East Coast Residency. His collecting was described by Bartlett (1935); Merrill studied his specimens.

1929–1931 — A.F. FREY-WYSSLING (Swiss; 1931a, b, 1932, 1933a, b; Backer, 1936). From 1929–1932 botanical assistant at the experimental station for the sugar culture (AVROS) at Medan. Total number of collections c. 200; in BO. He collected in the Gayo Lands (Takengon) and vicinities, and on the volcanoes Bur ni Telong and Bur ni Popandji, both in Aceh, also in the East Coast and other areas. *Rhododendron frey-wysslingii* was named after him (this species also occurs in Leuser). He discovered also new orchids described by J.J. Smith (1932).

1931–1932 — W.N. and C.M. BANGHAM. This American couple collected over 600 numbers, on behalf of the Arnold Arboretum, mainly in Dec. 1931 and in Jan.-Feb. 1932. Bangham was a botanist (cytologist) employed by the Goodyear Rubber Company, Dolok-merangir. The collections are most interesting according to Merrill (1934a, b) who identified them in collaboration with others. Bartlett (1935) gave a chronological enumeration with collecting localities. Collections are from the East Coast (Karo Lands) and adjacent NE Tapanuli, but also from Aceh, including Takengon on Lake Tawar and vicinity.

(1927), 1934, 1937 — C.G.G.J. VAN STEENIS; see Van Steenis-Kruseman (1950, p. 499, portr.) and Van Steenis (1938). Assistant at the Buitenzorg Herbarium (Herbarium Bogoriense), founder of the Flora Malesiana (1948), finally Professor of Systematic Botany, Leiden, and Director of the Rijksherbarium (1962–1972).

In December 1927, Van Steenis collected a few plants on Pulau Weh on his way from the Netherlands to the Dutch East Indies (Buitenzorg); again on 31 December 1933 when on furlough to Holland.

In the period of 7 Aug.–9 Sept. 1934 on his way back from leave he made an exploration tour in northern Aceh, in anticipation of the large Leuser expedition of 1937. He traveled from Sabang to Kotaradja (now Banda Aceh) and from there by car to Bireneun and Takengon (Aug. 27), collecting at Alur Glung, W of the Goudberg (G. Mas) and S of Sigli; sojourn at Takengon (27 Aug.–7 Sept.), collecting at some high volcanic mountains North of Takengon, viz. Bur ni Gentella (Aug. 29), Lake Takengon (= Laut Tawar) (Aug. 30), Bur ni Bias (Aug. 31), Bur ni Lintang (Sept. 1), Bur ni Telong (c. 2600 m; Sept. 2), Bur ni Popandji and Laut Popandji (Sept. 3), Bur ni Geredong (c. 2600 m, volcano inactive; Sept. 3–5), S side of Lake Tawar, near Oneng (Sept. 7); Takengon to Lho Sumawhe

(Sept. 8); to Lho Sukun (and Medan) (Sept. 9). During this trip he collected no less than 835 numbers (5764–6599), various plants from the mountains being of great botanical interest, e.g. the new endemic species *Pyrola sumatrana* (Andres, 1936; Sleumer, 1967) and new records for Sumatra, e.g. species of *Geranium* (*G. nepalense*, only collection for Malesia), *Laurembergia coccinea, Mimulus tenellus, Schoepfia fragrans, Swertia* (e.g. *S. bimaculata*), and others, most of these with their main distribution in continental SE Asia. Also *Symplocos atjehensis* was first found.

All these mountains mentioned are volcanic and it appeared that the old volcano Bur ni Geredong yielded more interesting plants than the active volcano Tèlong.

In continuation of this preliminary visit to North Aceh in 1934, three years later, from 27 Jan. to 24 March 1937, the large Mt Leuser (Losir) expedition took place under his direction throughout the mission, with extensive botanical exploration in areas within or close to the present Gunung Leuser Park. During this expedition Mt Leuser, Mt Kemiri, and Mt Gohlembuh were climbed, and a tour was made into the vast Kappi area. In all, Van Steenis collected 2028 numbers. These are collections of basic importance for the botany of the Leuser Park. The itinerary is briefly summarized by Van Steenis-Kruseman (1950, p. 500), and described in detail (Dutch) by Van Steenis (1938).

The collections, especially those from the high mountains, contained a number of surprising novelties, such as *Centrolepis, Danthonia oreoboloides* (*Monostachya*), *Oreobolus,* and *Patersonia,* which induced Van Steenis to modify his concepts of the pathways of immigration of mountain plants as described in his 1936 treatise on the origin of the Malesian mountain flora. A more detailed account of Van Steenis' travels is given below in a separate section.

1936 — W.J. SCHEEPENS. Lieutenant in the Dutch East Indian Army (see Van Steenis, 1938, p. 738), at the time at Blangkejeren, towards the end of that year at Bakongan. In anticipation of the Leuser expedition under Van Steenis he found a track to that mountain during a patrol from 28 October to 5 November 1936; actually he was the first European to reach the summit which appeared to consist of three tops, viz. East, Middle, and West Top (c. 3400 m). Also, he was the first to see the large waterfall of the upper Alas River close to the mountain. On his arrival in Blangkejeren in January 1937, Scheepens handed to Van Steenis some 12 fragmentary plant specimens from the top area of the Leuser, incl. *Lobelia sumatrana, Parnassia* aff. *wightiana* (probably a new species), *Potentilla borneensis* (Sojàk, 1992, distinguished this as *P. sumatrana*), and *Viola biflora*. These first specimens from the Leuser top area are now preserved in BO. During a second tour to the mountain in the beginning of January 1937 under lieutenant J.H. COX depositories of food (rice and dried fish) were made in two places along the same track which was later that month to be followed by the large Van Steenis party. Previously as well as later on Scheepens made several more extensive patrols in the Leuser complex area (Doup, 1939) without any botanical collecting, however.

1937 — AMIROEDDIN. According to the report of the Leuser expedition of 1937 (Van Steenis, 1938) Amiroeddin collected during the expedition in several places in the Senubong Range (at the beginning of the track to Leuser mountain), e.g. at Mt Bohgani (1900 m) for which he was previously instructed by Van Steenis. He was a mantri (assistant) of the forestry centre at Langsa (E Aceh) and gathered some 130 wood samples with accompanying herbarium material now at BZF (see further under Forest Research Institute). Most likely, while employed at Langsa Amiroeddin collected more specimens in Aceh.

1939 — S.D. RIPLEY and F.A. ULMER Jr. Americans who attended the mainly zoological George Vanderbilt expedition to North Sumatra as field collectors. They assembled a small collection of plants from the Leuser top zone, several of which were later described as new species by Merrill (1940). The progress of this expedition was briefly described by De Schauensee & Ripley (1940). They followed almost exactly the same route to the Leuser tops as Van Steenis' party in 1937. Forty years later, in 1975, De Wilde also followed this route to the top area. His party returned along this same path, whereas Van Steenis descended along a different trail more to the East.

Their main base camp was at Blangbeke, that is, on the large blang area at the place where the upper Alas River had to be crossed at c. 2300 m alt.; the Leuser top was reached from the NW passing several bivouacs as indicated on the published map; like Van Steenis they descended towards the East.

The actual exploration and climbing of the Leuser by the Vanderbilt expedition took about 1.5 month, 28 March–11 May, during which time many animals, mainly birds, were collected. Ripley gave in his report descriptions of the vegetations and good photographs showing landscape and vegetation rather similar to some of those published by Van Steenis (1938).

Curiously enough, the Van Steenis expedition of 1937, two years earlier, was not mentioned in De Schauensee & Ripley's report (1940), and only a very short reference is made of Hoogerwerf, who during that same expedition did extensive ornithological collecting (see further under Van Steenis).

Merrill (1940) presented a brief impression regarding the c. 80 numbers collected, mentioning the presence of species of two species of *Ainsliaea*, a *Gentiana, Lactuca, Primula, Senecio, Swertia, Viola,* and others. He noted that the Leuser supports a particularly interesting flora worth of further exploration and then, separately, he listed the following eleven species (of which seven were described as new and of particular interest):

— *Patersonia lowii,* new for Sumatra, otherwise known from Kinabalu, Mt Halcon (Mindoro), and New Guinea, the genus being essentially Australian.
— *Parnassia* aff. *wightiana,* a typically north-temperate genus, new for Malesia.
— *Potentilla leuconota* (= *Potentilla borneensis*). The genus with its main distribution in SE Asia, the species new for Sumatra; also occurring in Borneo.
— *Sorbus granulosa* (= *Micromeles corymbifera*), known previously from SE Asia and Malaya, in Sumatra extending South to beyond Kerinji.
— *Gentiana pachyphylla,* new spec., endemic.
— *Gentiana ulmeri,* new spec.; endemic.
— *Lobelia sumatrana,* new spec.; endemic.
— *Primula sumatrana,* new spec. (= *Primula prolifera*).
— *Rhododendron adinophyllum,* new spec., a local endemic.
— *Rhododendron ripleyi,* new spec., a local endemic.
— *Rhododendron vanderbiltianum,* new spec., a local endemic.

Note – Some more new taxa in *Rhododendron* from the same area have been described later on by Sleumer (1967).

1971 — K. IWATSUKI (ferns and mosses), with J. DRANSFIELD (palms), HIRANO (algae), and others. This mainly Japanese party visited N Sumatra (4 Aug.–20 Sept.), collecting at Sibolangit, Lake Toba, Sikundur (E side of the Leuser Park), the Gayo Lands,

incl. the area of Laut Tawar (N Aceh). In mid-August they climbed Mt Kemiri in the Leuser Park following about the same route as Van Steenis did. The number of specimens collected is unknown to the writers, probably not more than a few hundred; see Jacobs (1972).

1971–1974 — H.D. RIJKSEN (with A. RIJKSEN-GRAATSMA). During their field study of the biology and conservation of wild Orang Utan in the Ketambe research area, for WWF (Netherlands), they collected over a hundred voucher specimens of interest for their study, mostly food plants. A list of these specimens, preliminary identified (*Ficus*, mainly strangling figs, by E.J.H. Corner of Oxford), was published in their book on Orang Utan (1978). The specimens are preserved in L.

1972 — E.F. DE VOGEL. Staff-member of the Rijksherbarium, Leiden. He made during his 3-year stay in Indonesia studying tree seedlings (De Vogel, 1979) a collecting trip to N Sumatra, July 8–25, visiting Ketambe. He joined De Wilde on a tour into the interior of the Park above Ketambe, reaching Mount Ketambe (with limestone, at c. 2000 m altitude) and collecting along Lau Ketambe and on ridges in the foothill and montane area. He collected also in the Ketambe research area and at Sibolangit. Mostly ripe fruit or seeds were collected, with voucher herbarium specimens, up to over 150 numbers (See Van Steenis-Kruseman, 1974, p. cii).

Towards the end of 1988 he (with the German P.J.A. Keßler, Leiden) went to the Lake Toba area (NW Tapanuli) to collect mainly Orchids, including living plants for the Bogor and Leiden gardens.

1972, 1975, 1979, 1985, 1991 — W.J.J.O. DE WILDE & B.E.E. DUYFJES, for Rijksherbarium Leiden, financed by WOTRO, The Hague, and NCI, Chicago. They made, together with various assistants or counterparts from BO, extensive collections in various parts of the Park and vicinity, altogether more than one year of collecting work. Their itineraries and collecting locations, dates, and numbers are the subjects of a separate chapter.

1975–1976 — N.J. VAN STRIEN (with T. VAN STRIEN-RAVENSBERG), for WWF (Netherlands). They made very extensive field explorations in the mountainous interior part of the Park to study the Sumatran Rhinoceros (Van Strien, 1985). He also wrote a detailed conservation/management plan for the Leuser Reserves containing a wealth of information on the Park (Van Strien, 1978). He collected a small number of mostly sterile voucher specimens of Rhinoceros food plants now preserved at L.

1976–1978 — C.P. VAN SCHAIK with M.A. VAN SCHAIK-VAN NOORDWIJK (1976–1977) and C.L. SCHÜRMANN (1976–1978). These primatologists studied the behaviour of Sumatran long-tailed Macaques and Orang Utans mainly in the Ketambe research area (Van Schaik, 1985). Initiated by Rijksen, a network of trails was made in the research area of c. 150 ha, necessary for the adequate observation of the animals. About 1800 trees were mapped and numbered, many of the same species, even so an estimated 400 species were involved (see Jacobs, 1978). Both Van Schaik and Schürmann collected some hundred voucher-specimens each, mainly of food plants, now at L. A list of c. 70 plant species observed during phenological studies was published by Van Schaik (1985).

c. 1980 onwards — Collectors of the Herbarium Bogoriense (BO). In 1980 the American C.H. LAMOUREUX, with students, visited Ketambe mainly looking for ferns. Apart from the assistants from BO who joined the expeditions by De Wilde (see there) a considerable number of persons on behalf of the herbarium visited the Leuser Park or its vicinity, especially Ketambe, Bohorok, and the Alas valley, mainly for forest ecological research. They made either small or fairly large collections of herbarium specimens or (sterile) voucher

specimens, as well as gatherings of living plants for the botanical garden. The actual amount of these collections is unknown to us; of most collections no duplicates have been sent to L.

The Bogor missions, since 1980, are listed below:

1980 — Jan.–Feb. Rochadi Abdulhadi, Dirman, Sugardjito; with Lamoureux (see above).
1980 — Sept.–Oct. Rochadi Abdulhadi, Imanudin, Kartawinata, Sukatmo.
1980 — Djuaeni, Prawiroatmodjo, Waluyo.
1980 — Afandi Ma'ruf, Latief Burhan, J.P. Mogea.
1980 — Danimihardja, Hidayat, Maskuri, Wiriadinata.
1981 — Dirman, R. Yusuf.
1982 — Feb.–March. Abdulhadi, Dirman, R. Yusuf.
1982 — March–April. K. Kamadibrata, H. Soedjito.
1982 — June. H. Soedjito, R. Yusuf.
1982 — Aug. Rochadi Abdulhadi, Ismail, Afandi Ma'ruf, Partomihardjo.
1982 — E. Mirmanto (partly with Van Schaik).
1983 — J.P. Mogea with Komarudin, Taryadi, R. Yusuf.
1983 — Rochadi Abdulhadi, Hardjono, Maskuri.
1983 — A.B.N. Zahro (to South Tapanuli).

Note – For Mochtar (1972, 1975, 1979), Maskuri (1979), Ismail (1985), Agus, Dachriyani, and Dadi (1991), see for their itineraries under De Wilde.

REPORT OF THE BOTANICAL EXPLORATION TOURS BY C.G.G.J. VAN STEENIS IN THE GAYO LANDS, ACEH, 1937

The scientific interest in the flora of northern Sumatra, especially in that of the non-volcanic mountains of Aceh, was initiated by Van Steenis as a consequence of his investigations on the origin of the Malesian mountain flora (Van Steenis, 1934, 1935). These indicated that the flora of the high mountains of Aceh would have played a major role in the explanation of the origin of the vegetation, which will be discussed in a later chapter concerning the actual scientific importance of the floristic composition of the mountain flora of Aceh. During his preliminary orientation tour in the area (on his way back from leave to the Netherlands, anticipating the large Leuser expedition of 1937, also exploring high mountains in the vicinity of Leuser) Van Steenis visited the surroundings of Lake Takengon and climbed some higher mountains nearby. These mountains, although not reaching 3000 m, yielded most interesting mountain plants of a distinct northerly affinity, like *Pyrola sumatrana, Schoepfia fragrans, Swertia bimaculata,* and other plants, and hence promised more exciting findings on the other still higher tops of the area.

The high non-volcanic mountains of Aceh are floristically unique in the region because of the presence of extensive areas of short species-rich heath-like vegetation, called mountain-blang or blang.

These introductory explorations, as well as his large expedition of 1937, were related in detail by Van Steenis (1938) in his report in Dutch entitled (translated): "Exploration in the Gayo-Lands – general results of the Losir-expedition 1937". This publication contains many illustrative photographs of the vegetation and of individual plants, but has not become very well known internationally. Apparently frustrated by the quick publication of a number of

new species from Mt Leuser by Merrill (1940) based on specimens collected by Ripley and Ulmer (see there) during the George Vanderbilt expedition in 1939, and awaiting monographically-based identifications of his specimens, Van Steenis never came to a more internationally orientated publication of the scientific results of his 1937-expedition.

Therefore, we here present a rather detailed account of Van Steenis' itineraries during his Leuser expedition, 1937, excerpted from the report as published by Van Steenis (1938), with emphasis on the vegetation encountered. In our later analysis of the flora and vegetation we will refer to many of his findings which induced Van Steenis to modify and adapt his ideas as published in 1936 on the course of the pathways along which the mountain plants penetrated into Malesia. A selection of interesting plant discoveries extracted from Van Steenis' annotated field books, which became available after his death in 1986, has been incorporated in our floristic analysis.

The Leuser expedition of 1937 consisted of 4 separate tours, viz. 1) the ascent of Mt Leuser, 2) the ascent of Mt Gohlembuh, a mountain North of the present Leuser Park, 3) climbing Mt Kemiri, and 4) an exploration of the so-called Kappi terrains, a forested rather flattish montane area, which forms the NE part of the present Leuser Park.

Mt Leuser and Mt Gohlembuh were climbed by large parties, Mt Leuser by 91 persons in total, including 5 Europeans, viz. the military men Cox and Rietveld, the topographer Clements, the zoologist Hoogerwerf (Hoogerwerf, 1939), and Van Steenis himself as botanist and expedition leader; the remainder being carriers among which a chain gang, convicts serving their sentence. The other two tours were performed by much smaller parties directed by Van Steenis alone. Total number of collections 2029 (nos. 8266–10294, including Cryptogams: 10102–10292).

The expedition was held in the beginning of the year, which is the prevailing period of the dry season in the area. Van Steenis stayed overnight in a bivouac at Mt Setan (Alas Valley) and proceeded NW along the horse trail in a three-day march to Blangkejeren in the Gayo Lands (23 Jan.). Four more days were needed for the preparation of the first tour to Mt Leuser (Fig. 3).

1. The ascent of Mt Leuser, 27 Jan. – 8 Feb., 1937

Summary of itinerary:

Starting from Blangkejeren (c. 900 m) via Penosan to bivouac I (2350 m) on the ridge to Pucuk Angasan (see note on localities with similar names, below) (27 Jan.); bivouac I via summit Pucuk Angasan (2700 m) (Senubong Range) to bivouac II (2120 m) (28 Jan.); crossing the watershed (2400 m), descent to Lau Alas (Upper Alas River), and bivouac III above the Lau Alas (2240 m) (29 Jan.); following the ridge of the watershed to bivouac IV (2740 m) (30 Jan.); following the sharp crest of the large high part of the watershed to Alur bivouac V (2720 m) (31 Jan.); crossing the large plateau under the central summit of Mt Leuser, bivouac VI (3300 m) (1–4 Feb.), collecting on the central top (nearly 3500 m) (2 Feb.), along the alur (rivulet) (3 Feb.), on the ridge to the western summit and bog plateau around the bivouac (4 Feb.); via the central summit in the direction of the eastern summit to bivouac VII on a small blang (5 Feb.); from about 3000 m following a burnt ridge descending to 1800 m, with bivouac VIII (6 Feb.); following the slope further down to the Lau Alas where the place of bivouac IX (7 Feb.); from the Lau Alas (1220 m) to the crest of the Senubong Chain (2500 m), close to Mt Pucuk Agusan, and back to Blangkejeren (8 Feb.). For maps see Van Steenis (1938). Collected number of Phanerogams: 517 (nos. 8266–8782).

Note – Mt Pucuk Agusan should not be confused with Mt Pucuk Angasan, the high mountain of 2700 m climbed on January 27. See also map by Van Beek (1982). Between Blangkejeren and Kongke is a watershed also called Agusan at 1200 m (see March 4).

Jan. 27 — Starting from Blangkejeren (c. 900 m) by way of the village Penosan (2 hours walking to the West) and from there proceeding in a southern direction, at first moderately rising through sawah-land, then through hilly *Pinus*-blang, reaching the sharp-cut natural forest edge 'pintu rimba' (gate of forest) at c. 1500 m. In this area the mantri Amiroeddin of the forestry-service (see list) remained behind to make a botanical collection of forest trees. Then climbing a side ridge of the Senubong mountain chain, direction Pucuk Angasan, passing through mountain forest. Mossy forest starts at 1800 m. First bivouac (bivouac I) at a formerly burnt site on the ridge in ericoid forest at c. 2350 m. In the depressions is mixed mossy forest with *Acer niveum, Exbucklandia populnea,* etc.

Jan. 28 — Following the ridge further upwards, to Pucuk Angasan (c. 2700 m), the highest top of the Senubong chain, underway with view in the distance to the North on Mt Abong-Abong, characterized by a very large and steep landslide. Smaller landslides are a common phenomenon everywhere on the steep forested slopes. On burnt places on the ridge shrubs of *Litsea* (later on described as *Litsea steenisii*) are common; apparently this is a pioneer species. On Pucuk Angasan the first extensive mountain blang areas are seen, mainly those of the dryer type. Exposed rock appears to be quartzitic sandstone, hence non-volcanic. (The non-volcanic character of the whole area is confirmed during all further tours.) Proceeding in mainly southwestern direction through upper mountain forest (ridge forest), passing some small open blang areas at 2250–2600 m and staying overnight in bivouac II (Mud-bivouac), in a partly marshy, rather open vegetation in a deep depression at c. 2120 m.

Jan. 29 — Progressively climbing up through montane forest to the watershed at c. 2400 m with rather tall ridge forest. Underway a shaded kolam (forest pool) along which the first sterile *Primula prolifera* at c. 2150 m; the edible leaves (called by the local people 'sawi hutan') are cooked and eaten with rice. From the watershed there is a magnificent view to theSouth over the upper Alas valley with in the depth a tall waterfall too difficult to reach. Then passing along the watershed to the West through various types of high-altitude mountain forest up to c. 2400 m, finally reaching vast blang-areas with scattered scrub and descending to the upper course of the Alas River. Crossing this swift-running still considerable stream at c. 2100 m, and making bivouac III (Alas bivouac) on a blang-area bordering the forest at the opposite side of the river (c. 2240 m). Exposed rock in the Alas-bed consists of shales and quartzitic sandstone. The soils under the blang as well as under neighbouring forest are investigated and appear to be nearly identical, a poor sandy clay, and the origin of the blang is judged by Van Steenis as mainly the result of burning and subsequent loss of most of the top-soils by erosion, even causing bare rocky areas. Occasionally there are bare places with fine-white sandy soils, inundated during rains, and erratic white or brownish rock blocks of apparently pure quartz. On these blang areas most of the typical blang species are found, including abundant and gregarious *Patersonia lowii,* a species occurring only here, not found elsewhere in the area.

Jan. 30 — Continuing along a ridge with upper montane and ericoid forest towards the sharp watershed South of the upper Alas River, making bivouac IV at c. 2740 m on a small plateau at the lower end of the next ridge to be climbed the following day. At some places are small pools in depressions, some almost covered with bright green floating or submersed *Sphagnum*; small dry blangs are here and there on the ridges. Low scrub is mainly com-

posed of *Ericaceae* and usually the myrtaceous *Leptospermum flavescens*, a species which is commonly a taller tree (often densely clad with lichens, incl. *Usnea*) of the mountain forest occurring especially on the ridges.

Jan. 31 — The fifth day a narrow ridge in SE direction is followed, passing through various types of subalpine ridge vegetation, with fine outlooks to the West coast of Aceh where the *Cimara* (*Casuarina*) trees can be seen on the beach. Bivouac V (Alur bivouac, at 2720 m) is established in a depression in humid subalpine forest close to a brooklet, a habitat for various curious plants including *Galium* spec., an unidentified *Lactuca*, *Pyrola sumatrana*, etc. Base rock in this area appears to be almost everywhere non-volcanic layered quartzite.

Feb. 1–4 — Exploration of the top area. The sixth day, 1 Feb., the Leuser Central top (3466 m), the highest of the three Leuser tops (summit of West top c. 3400 m, the East top is lower) is reached; the base camp (Top-bivouac or bivouac VI) is made at c. 3250 m not far from the Central summit and close to an extensive wet and peaty blang area.

Approaching the area, the party gradually ascends along the ridge, passing through stunted forest on the ridges with small open places and thicker-stemmed mossy forest in the depressions. Towards the top a spot of burnt forest and scrub on a hillock testifies of imprudence of a previous military patrol. At c. 3000 m the ridge ends passing into a wide gentle slope, first with thickets and scrub, then giving way to small and large blang areas, of dry as well as of wet types. Here, for the first time *Danthonia oreoboloides*, forming minute 'polsters', is found, and also *Centrolepis fascicularis* with a similar habit. Together with *Oreobolus kükenthalii* these three species are very singular representatives of subalpine genera of eastern origin. The next days the surroundings of the base camp are explored. February 2 collecting on the central top and vicinity, discovering the yellow-flowered violet *Viola biflora*, the very peculiar *Pleiocraterium gentianifolia*, and a fair number of plants of typical northern ('Himalayan') origin (Van Steenis, 1934, 1935, 1938). The stony summit of non-volcanic quartzite is very windy, and many of the trees show typical oblique wind-forms. This day Clements moves on to the West-top for the construction of the triangulation pillar; later on he will proceed over the steep western slopes (Krung Baru-rift) to Blang Pidië on the West coast.

In the top area, at c. 3250 m, the forest is composed of oaks (*Quercus*), two species of *Dacrydium*, and further *Ilex*, *Viburnum*, and cf. *Gordonia vulcanica* (resembling *Schima wallichii* subsp. *brevifolia* from the mountains of Borneo). Even at these altitudes trees may reach sizes of up to 15 m tall. February 3 is used for the inventory of the brooklet close-by and, again, of the vast damp peaty blang-area (bog plateau) with in places abundant *Sphagnum*. Scattered is scrub and mountain coppice. Apart from a great variety of typical herb species of these blangs findings like *Berberis wallichiana*, *Ranunculus javanicus*, and especially species like *Anemone rivularis*, *Hypericum leschenaultii*, *Parnassia* aff. *wightiana* (Photograph 4), and a new species of *Rhododendron* (later described as *R. vanderbiltianum* by Merrill) are to be mentioned. *Nepenthes* is lacking at these altitudes, above 3000 m. The last day, February 4, the ridge in the direction to the West-top and the boggy places on the plateau around the bivouac are explored.

Feb. 5 — Collecting in the peaty blang at c. 3250 m. At noon breaking up camp; first following the narrow path below the Central top, then proceeding on the broad ridge to about half-way the East top, with bivouac VII on a small blang-area at c. 3000 m. On the way are thunderstorms and rain, later on much fog. The same day Cox and Hoogerwerf return from their tour to the West top.

Feb. 6 — Proceeding to the Leuser East-top (slightly over 3000 m) through low subalpine forest, then descending in mainly NE direction along a vast slope of c. 15 km length

down to c. 1800 m; the slope has been burnt quite recently; bivouac VIII is made at c. 2940 m on this burnt ridge. The charred remnants of tree trunks and the water-shoots sprouting from the charred root systems and rootstocks show that the mountain forest and scrub mainly consisted of oaks (*Quercus*) and *Myrtaceae* (presumably mainly *Leptospermum flavescens*), as well as of *Dacrydium elatum, Ilex,* cf. *Litsea, Schefflera,* and *Vaccinium.* There are also perennial herbs and ferns including *Dipteris* and *Pteridium aquilinum*; *Gnaphalium longifolium* only occurs sporadically. On steep sloping places the top soil has been washed away completely causing bare rocky stretches on which presumably never any vegetation will regenerate. The bare rock is mainly quartzitic interspaced with some andesitic intrusions; in some places the rocks show striking mushroom-like forms apparently caused by wind erosion.

Feb. 7 — Proceeding further down along the burnt ridge, which is sometimes narrow as a crest with deep ravines beside. Forest is dense mountain forest, occasionally with forest pools. Sometimes passing through fields of the tall sedge *Lepidosperma chinense* with scattered *Drosera spathulata* on the ground. Here and there are stony landslides overgrown with *Pinus merkusii.* Finally, through dense mountain forest descending into the Alas valley, the river here already of considerable width with sand and gravel banks which carry a 'natural secondary' vegetation. Bivouac IX at c. 1220 m.

Feb. 8 — Climbing out from the Alas River-bed, crossing the forested Senubong mountain chain (c. 2500 m, also called Agusan Mountains of which the Pucuk Agusan is a part, c. 20 km to the East of Mt Pucuk Angasan, see 27 January). Initially up through mountain forest, then passing open grassy fields with scattered *Pinus,* proceeding further North. The top ridge, again, is covered with mossy and ericoid forest at c. 2000 m. After a steep descent crossing a small brooklet at c. 1500 m, leaving the mountain forest behind, and through open sunny lowland 'blang' back to Blangkejeren.

2. Tour to Mt Gohlembuh, c. 3050 m; 15 - 27 Feb., 1937

Summary of itinerary:

Mt Gohlembuh is situated outside the present Leuser Park rather to the North of Blangkejeren. The jaunt was made in the company of the military (with lieutenant Freudenberg) and (for a part of the tour) the zoologist Hoogerwerf, all in all 81 persons.

Leaving Blangkejeren to Gadjah (15 Feb.); Gadjah–Oreng–Pendeng (16 Feb.); Pendeng–Aer Putih (17 Feb.); ascent of Mt Gohlembuh to 1850 m (18 Feb.); bivouac at 3025 m (19–22 Feb.), collecting in the summit area (3044 m), also in a ravine of the alur; descent to Moss-bivouac (1850 m) (23 Feb.); to Fall-bivouac (600 m) (24 Feb.); Aer Putih–Pendeng (25 Feb.); Pendeng to Gadjah (26 Feb.); by way of the watershed (c. 1700 m) back to Blangkejeren (27 Feb.).

Feb. 15 — Starting from Blangkejeren (c. 900 m) walking in eastern direction along the foot trail to Gadjah, passing extensive *Pinus*-blang, then through montane forest (watershed at c. 1700 m), and again through blang country to Gadjah (near Oreng) at c. 1000 m altitude. On the way various soil types and bed rock are seen, including shales, gravel-banks and limestone layers.

Feb. 16 — Descending through *Pinus*-blang areas, and then through lowland forest along the upper Oreng River to Pendeng at c. 200 m situated in a beautiful valley with wet

rice fields amidst primary tall humid dipterocarp forest with a rich herb vegetation of *Phyllagathis, Pentaphragma, Zingiberaceae*, etc.

Feb. 17 — Following the Oreng River downstream to the North, along the horse-trail, to Lokop. The water is running over banks of rolling stones and gravel, here and there with the typical rheophytic shrub *Homonoia riparia* with its characteristic elaborate root system. The dense riverine forest is rich in *Pometia pinnata*. At the left-hand side the base rock usually is limestone (karang). *Epithema*, a member of Gesneriaceae, is found growing on quartz blocks; apparently this rather is a rock-plant not a limestone indicator.

The forest is entered at the place where a small side stream, the Aer Putih, flows into the Pendeng River. Proceeding upstream Aer Putih for several hours, making bivouac near the waterfall (Fall-bivouac) at c. 600 m, a site close to the beginning of an immense ridge, which goes in mainly western direction right up to the summit area of Mt Gohlembuh.

Feb. 18 — Climbing the ridge, passing through lower and upper montane forest and ridge-forest, to a camp site at c. 1850 m (bivouac Halfweg or Moss-bivouac) close to a small brooklet. In the mountain forest between 1400 and 1800 m rather commonly the mountainous *Rafflesia* aff. *hasseltii* with orange-rusty-red flowers of up to 35 cm across is found. Most *Rafflesia* species are restricted to lowland forest. Van Steenis mentions that the diaphragm is 5-lobed (a feature also characteristic of most specimens of the new species *Rafflesia micropylorum* described by Meijer (1984) from specimens from the Ketambe lowland forest). For these mountain forests Van Steenis records several species of *Didymocarpus*, incl. the beautiful *D. vandaalenii* Valeton ined., as well as various other typical forest herbs like *Argostemma*, etc.

Feb. 19 — Continuing on the same ridge through upper montane and subalpine forest and ridge forest, making bivouac at c. 3025 m, near one of the summits (pillar at 3044 m; the other top appears to be slightly higher but cannot be reached as they are separated by a deep ravine). In the mountain forest an interesting bright red-flowered *Impatiens* (*Impatiens rubriflora* Grey-Wilson, 1989) is found. Mountain blang areas with signs of human disturbance by burning and cutting appear when reaching the high plateau. The blangs here seem slightly dryer as compared to those of the Leuser complex. The bedrock seen consists of sandstone and shales (with quartzite sheets mixed-in) usually in a vertical position and conglomerates. From the top the following topographic items in its surroundings can be seen: Laut Tawar, Mt Kliótón, Mt Geredung (with one solitary tree on the flat top area), Mt Telong, Mt Leuser, Mt Kemiri, Mt Bandahara, Mt Abong-Abong, with a large earth slide on its flank, the sea with the island Pulau Sembilan in the Aru Bay, the lights of the towns of Langsa and Lokop, and the plain SE of Blangkejeren.

Feb. 20 — Exploration of the top area around the pillar, and again of the extensive blang areas (mainly of the dryer type), and of scattered mountain scrub and mossy and elfin forest. Most blang species of the Leuser are found also here, incl. *Pleiocraterium gentianifolia* (not frequent and as a differing form with smaller leaves and smaller flowers), but not *Parnassia, Primula, Ranunculus, Senecio sumatrana*, and *Viola biflora*. On Mt Gohlembuh but not on Mt Leuser are found: a white-flowered *Gentiana, Lysimachia laxa*, and *Lobelia* (*Pratia*) *montana*. Apparently the floras of these two adjacent high mountain tops are somewhat different.

Feb. 21 — Continuation of the botanical exploration of the high plateau of the top area. Hoogerwerf left the party continuing his zoological field work in the Gayo Lesten. Base rock in the top-area appears to be shales, breccia (discordant), and quartzite. There are

many signs of wind-erosion. On the stony plateau is low scrub of *Leptospermum, Rhododendron,* etc., the ferns *Dipteris* and *Gleichenia,* and some mosses in the form of mini-polsters. In rocky water-holes are submersed mosses and green and blue algae. The sharp edge of the mossy forest lays some c. 700 m lower down with in the blang-edge vegetations of *Lepidosperma chinense,* with *Drosera spathulata* on the bottom. The latter occurs in a large area from New Zealand to China, but was in Malesia only known from the Philippines and Kinabalu. Also collecting in a close-by ravine with a small brooklet. Some lichens from the blang plateau are noteworthy: *Baeomyces* (with pink apothecia) on damp, muddy places, a white *Stereocaulon* sometimes overgrowing rock-blocks, and *Usnea* hanging from the vertical rocks, etc. After continuous rains a clear-sky night follows, and the lowest temperature of all expeditions is measured here 2.5°C.

Feb. 22 — The last day in the Mt Gohlembuh top area; clear weather which permits excellent view to all sides, and many details of the eastern coastline of Sumatra can be seen.

Feb. 23–27 — Return to Blangkejeren following the same route as the way going up; Feb. 23: descent to 'Moss'-bivouac, 1850 m; Feb. 24: to Fall-bivouac (600 m), collecting fruiting material of *Citrus* cf. *macroptera,* a wild citrus tree, 10 m tall with dark stem, long-slender thorns and globose, yellow-green fruits, 15–20 cm diam., of bitter taste; fruits of a wild mango (*Mangifera*) are collected, to be planted in the botanic garden in Buitenzorg; Feb. 25: Via Aer Putih (Waterfall bivouac) and the Pendeng River valley to Pendeng; Feb. 26: From Pendeng to Gadjah (c. 1000 m); Feb. 27: From Gadjah via the watershed at c. 1700 m back to Blangkejeren. Above Gadjah there is below the watershed at c. 1400 m a small lake, Laut Gadjah, which appears shallow and almost dry in the dry season. It is largely overgrown with marshy vegetation of sedges and grasses, and several *Polygonum* species (incl. *Polygonum viscosum*). The way back to Blangkejeren (950 m) passes respectively through mountain forest, between 1700–1300 m, then tall grass-wilderness (from which Van Steenis records young treelets of *Pinus,* a terrestrial *Psilotum, Pteridium aquilinum, Themeda gigantea*), and finally over open *Pinus*-blang.

3. Ascent of Mt Kemiri, 3314 m; 4–13 March, 1937

Summary of itinerary:

The pillar on Mt Kemiri or Bur ni Geumpang was constructed by the topographer Clements in 1931; the military man Scheepens climbed the mountain in 1936; later Mt Kemiri was climbed by a party of Iwatsuki & Dransfield (in 1971), by the pedologist Van Beek (1982), and by Whitten with students (1984).

Van Steenis ascended the mountain with 22 carriers, starting to walk from Blangkejeren (c. 900 m) to Paloh and Kongke (4 March); Kongke – Gumpang – bivouac I on Mt Kemiri, 1360 m (5 March); to bivouac II, 2800 m (6 March); to summit Mt Kemiri, 3314 m (7 March); collecting near the summit (7–9 March); descent to bivouac II (10 March); descent to bivouac I (11 March); bivouac I – Kongke (12 March); Kongke–Paloh and back to Blangkejeren (13 March).

March 4 — Walking from Blangkejeren by way of the main road, a horse trail, via Paloh, and the watershed at Agusan (1200 m), down to Kongke (c. 1000 m) in the upper Alas valley.

March 5 — Proceeding on the main road from Kongke further South to Gumpang. Above Kongke traversing a curious vegetation on steep limestone and sand and gravel slopes and

on limestone rock with singular plants like a beautiful *Boea* (= *Paraboea paniculata*), some *Didymocarpus* species, a bright yellow-flowered orchid *Paphiopedilum* spec. (this orchid not collected), and a blue-flowered *Viola*. Near Gumpang crossing the Alas River, then passing through belukar area (secondary scrub vegetation), finally entering tall forest; ascending subsequently Mt Kemiri on the eastern slopes, passing through submontane forest, following a ridge (montane ridge-forest) and making bivouac I at c. 1360 m. In this season the absence of water is a problem; it can only be secured far behind from the deep ravine below the ridge. The lower mountain forest is rich in ground herbs with several species not seen during the precious tours; higher up there is a dense undergrowth of rattan.

March 6 — Proceeding on an eastern ridge of the mountain through upper mountain ridge forest with at c. 1800 m a group of several old, emergent, giant *Pinus merkusii* growing close to an instable area of land slides with a 'naturally secondary' vegetation. The crowns of the *Pinus* trees carry a rich epiphytic flora of moss cushions and ferns (unlike the pine trees of open sunny and drier blang). Then passing through mossy forest, reaching a ridge with ericoid vegetation partly burnt and regenerating with pioneer species as *Litsea steenisii* (erroneously called *Litsea citrata* by Van Steenis because of its citrus-smell when crushed) and sedges as *Gahnia* and *Scirpus*. Finally reaching the margin of the high plateau, still densely forested, and making bivouac II at c. 2840 m in a deep ravine containing only water in some deep rock-pools in the otherwise dry stream bed. Here interesting plants as the parasite *Rhopalocnemis phalloides*, and higher up in moss-rich forest abundantly growing *Gentiana ulmeri* and the 'eastern' liverwort *Calobrium blumei* are found.

March 7 — By way of mossy forest and ericoid vegetations on the ridges reaching the top region of the vast highland plateau (c. 3000–3300 m) with extensive mountain blang areas especially in a valley in SW direction. The blang vegetation is largely identical with that of the Leuser complex and includes the same three 'eastern' species, members of viz. *Centrolepis, Danthonia,* and *Oreobolus,* and the new species *Lobelia sumatrana*. The first three species and *Eriocaulon* are especially beautifully developed forming small 'polsters' or rings on places were apparently the vegetation was formerly destroyed by previous patrols in 1931 and 1936. The 'weeping' *Dacrydium*, erect-growing or as a flattened wind form, is also present. Near the pillar (3314 m) the bivouac for the next three days is installed. Rock formations are all quartzitic. On the mountain blangs scattered erratic blocks of pure, white quartz are found clad only here and there with small cushions of greenish-black moss. On the East slope, going from bivouac II towards the top *Festuca sumatrana* was collected, a species never found again.

March 8 — Further botanic exploration of the summit area, mainly in the extensive damp-peaty mountain blang valley with a small brooklet meandering over the rocky bottom and in and under the peaty soil (a beautiful colour photograph of the Kemiri high mountain blang, with a peaty *Sphagnum* pool in the foreground, is presented by Whitten et al. (1984, opposite p. 396). The vegetation here is mainly grass-like, with *Scirpus* and *Carex,* few grasses, and some more herb-species. Along the brooklet abundant *Anemone* cf. *rivularis* and *Primula prolifera*; in the water are liverworts, floating *Scirpus beccarii* (*'Scirpus fluitans'*), and the long and slender purple roots of *Senecio sumatranus*.

March 9 — Again inventory of the mountain blang areas, mainly between 3000 and 3300 m; soils are peaty or stony or of gravelly quartzitic whitish sand; the short vegetation is mixed with scrub and thicket especially on elevations. There are also signs of former burning with remnants of forest or solitary relict trees like *Quercus*, etc., often overloaded with rusty-coloured cushions of liverworts.

March 10–13 — Return to Blangkejeren; March 10 descent to bivouac II; March 11 descent to bivouac I; March 12 proceeding, via Geumpang, to Kongke on the main road, en route herbarium collecting of trees in the forest edge; March 13 back to Blangkejeren, there several days preparing for the final tour through the Kappi area and the return to Java.

4. Tour through the Kappi area, situated at 1000–1600 m; 18–24 March, 1937

Summary of itinerary:

The Kappi area forms at present the NE part of the Leuser Park; it is a forested plateau area with mainly undulating country generally at 1200–1600 m altitude. During this tour Van Steenis visited Laut Tiga Sagi, an old crater lake, and the Pasir Lebar, a bare stony solfatara field. The forest mainly belonged to various forms of lower and upper montane forest. There were 14 carriers, including Aman Remah as mandur, and pawang Panglima Muda as guide (a mandur is the head of the other carriers; a pawang is an experienced forest dweller and usually a rhinoceros hunter). Starting from Blangkejeren, to Sangir River (18 March); to bivouac II (19 March); to bivouac III (20 March); Kappi plateau, 1200–1400(–1500)m, Kappi solfatara fields or Paya Kappi, bivouac IV (21 March); bivouac V at 1500 m (22 March); Laut Tiga Sagi to Pasir Lebar (23 March); via Aer Panas (Merpunga River) back to the main road (24 March).

March 18 — Starting from Blangkejeren (c. 900 m) in mainly SE direction (passing through extensive partly burnt *Pinus*-blang with undergrowth of grasses and *Pteridium aquilinum*), to about off Paloh (Palok) where the horse trail bends into the forest and over the pass to the Alas River valley; going straight on, descending into the valley of the Sangir River (that is, the upper reaches of the Tripa River), passing through country with some kampungs and much ladang-land, then through lower montane forest following a right-side arm of the Sangir River, staying overnight on an abandoned ladang, Bivouac I, no collections made.

March 19 — Following the riverbed and along a muddy path (at slightly over 1000 m) with a flora of mid-mountain herbs collecting in the forest edge *Sophora wightii*. Upstream taking a ridge, at first steep with forest on limestone, then through mountain ridge forest, still in SE direction (more or less parallel to the main horse-trail through the Alas valley, the present motor road), later on traversing terrains with high stemmed forest locally rich in rattans mainly on rather level country. Noteworthy trees seen here are *Eugenia* spec. of which the bark yields a red dye, and *Disepalum platypetalum* (*Annonaceae*) commonly seen as slender, curving treelets to c. 5 m tall or more. Bivouac II on this ridge.

March 20 — Proceeding on the same little sloping ridge, passing mountain forest with dense undergrowth of rattans, finally reaching a small rivulet which appears to be the upper reaches of the Aunan River. Continuing downstream until the terrain gets flatter and where the little stream is slow and meandering with sandy and muddy soil. Then taking again a low ridge, at last descending along a trail used by local forest dwellers down into a valley at the place where the Kappi River flows into the Aunan River. Bivouac III is made on a grassy field at the inner curve of the river opposite a steep rocky slope. The place is frequented by fishermen and is said to be close to the nearest 'sunan' or 'kawah', that is, a crater field.

March 21 — Climbing the steep slope at the opposite side of the river. After about an hour walking the forest becomes lower and thinner; the first cold solfatara field is reached. It is an extensive, barren and stony place with typical solfatara smell and sharply demarcat-

ed from the surrounding forest. Apparently these barren fields are of relatively recent date as many of the fallen dead tree trunks are still in good condition. The forest edge consists mainly of species normally present in the forest, hence the effects of the solfatara could be only very limited. Hot springs are absent; according to the many footprints pigs, deer, and elephants are common here, possibly they are attracted by the mineral-rich water. During the next hours several more kawahs are seen. There is also forest on limestone, e.g. on a ridge along the alur Dalem. Following this brooklet upstream the terrain gets flat again leading to a large open space with stinking (sulphur smell) blackish damp mud-soil, presumably an old silted crater lake at c. 1500 m. This lake has a marshy border vegetation of *Gleichenia vulcanica* and many other marshland herbs gradually passing by scrub (with stout *Pandanus*) into the surrounding forest. In this muddy site bivouac IV (Paya Kappi) is made.

March 23 — Visit to Laut Tiga Sagi and the solfatara field Pasir Lebar. The foregoing day camp had been made beside the effluent brooklet close to the old crater lake, which measures several hundreds of metres across. Around the lake are densely forested hills, a sort of ring-wall, with three higher tops, hence the name of the lake: Laut Tiga Sagi. It has a very marshy edge with many trees fallen towards the water. There is a zone of sedges standing in the water off its margin. Presumably the lake is an old crater lake and it is rather deep. The effluent rivulet called Pucuk Merpunga is apparently the source of the Merpunga River which discharges in the Alas River between km 66 and 67 on the main road through the Alas valley near a place called Rumah Bundur.

The extensive stony barren volcanic solfatara-field known as the Pasir Lebar is situated NW of the lake and could be found by going back the same ridge as the foregoing day (highest point c. 1600 m), then descending steeply to c. 1360 m to a flattish area through which the Merpunga mentioned above flows. From a distance the Pasir Lebar shows as a white stony barren slope. Close-by are marshy vegetations with many fallen trees and an undergrowth of *Elatostema, Pilea, Strobilanthes,* etc. It is largely surrounded by a zone dominated by ferns. The area itself is gently sloping with coarse porous corroded white quartzite rock blocks (not andesite); almost everywhere is a smell of sulphur. Also here there are no hot springs. The rocky field is largely barren except for incidentally some growth of *Lycopodium cernuum* and low *Ficus diversifolia* with large flat root-systems. At the lower side there is a small stream with acid water with some algae only and in places *Xyris melanocephala* is abundant. The forest-edge vegetation is similar to that of the smaller Kappi-solfataras with small-leaved *Eugenia* (with crooked copper-coloured stems), *Rapanea, Rhododendron, Vaccinium,* and along the brooklet locally *Melastoma.* The parasite *Korthalsella geminata* is seen growing profusely in the *Eugenia* trees. In the afternoon the party proceeds some three hours walking to the West making bivouac VI at about 1200 m.

March 24 — Proceeding down towards the main road in the Alas valley. Through high-stemmed mountain dipterocarp forest after some hours reaching the hot springs with small limestone-sinter formations of 'Aer Panas' in the Merpunga River at c. 580 m. The emerging water is about 90°C, even between the roots of *Melastoma* and *Saurauia* trees a temperature of c. 54°C is measured. In the steamy atmosphere the surrounding scrub is very mossy. Strings of blue algae fill the river. Further descending to the West passing through the steep valley of the river the main road is reached between km 66 and 67, between Meluwak and G. Setan, at about noon with which the tour through this interesting old-volcanic area has come to an end. That evening Kutacane is reached.

ITINERARIES OF THE EXPLORATION TOURS BY W.J.J.O. DE WILDE & B.E.E. DUYFJES

Chronology of their plant collecting, with localities and collection numbers in and near the Leuser Park

Introduction and generalities:

The area was visited on five occasions, in 1972, 1975, 1979, 1985, and 1991, all under the auspices of the Rijksherbarium, Leiden, in co-operation with Herbarium Bogoriense and sponsored by WOTRO, The Hague, and the 1991-tour by NCI (Frederick, MD / Chicago).

Exploration was performed in various periods of the year, in all covering more than one year of collecting. In total more than 9600 numbers have been assembled by now, the largest collection made in the area. The majority of these collections has five duplicates or more (first sets deposited in the herbaria of BO, L, K). Brief reports on the explorations have been published by De Wilde (1972), Jacobs (1974, 1976, 1980), Jacobs & De Wilde (1976), and Veldkamp (1986).

The first three missions were performed proceeding from a base camp at Ketambe (at c. 350 m) on the Alas River and comparatively large collections were made in that area. The Ketambe research area is situated in a varied forest on rather level ground comprising various alluvial terraces of the river. It is traversed by a network of narrow foot paths or trails used for zoological research, but which were also of advantage to the botanical inventory; see Rochadi and Manullang for a separate report on the vegetation of Ketambe in the forthcoming text book on the Leuser Park (Van Schaik et al., scheduled 1994).

Tours into the interior of the Park, on foot, were always performed in the company of local carriers, usually some 10 to 20 persons, some with jungle experience.

A brief account of our own exploration tours outside the Ketambe area is presented below. As with the account of the journeys by Van Steenis the various habitats (or vegetation types) examined or traversed are briefly indicated with cross-references to altitude and numbers collected and some noteworthy plants found in the various vegetations mentioned.

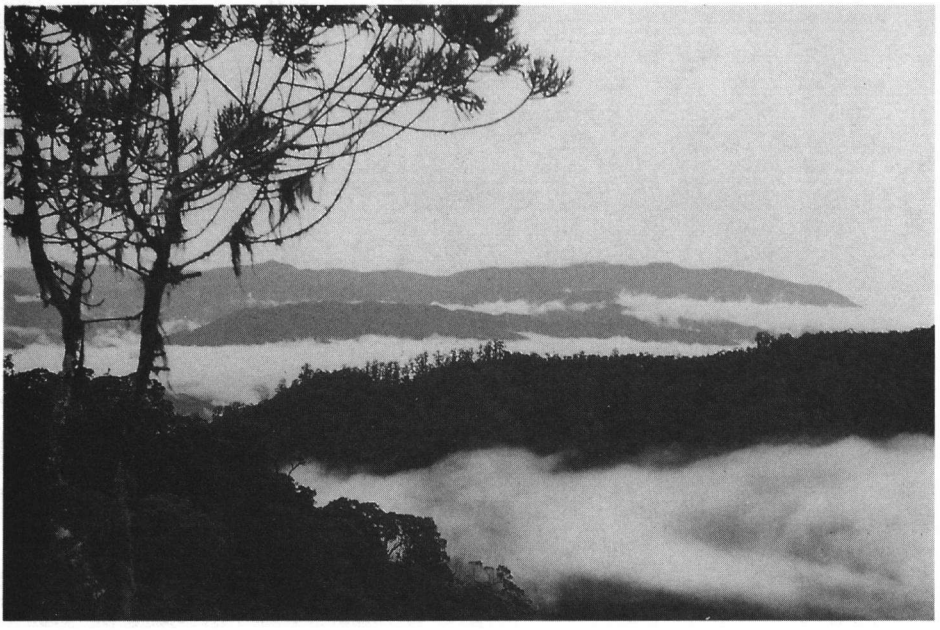
REPORT FOR 1972

Arrival at Ketambe May 16, departure September 4. The base camp at the Ketambe research station situated c. 35 km NW of Kutacane along the main road to Blangkejeren upstream the Alas River; c. 350 m alt.; c. 3°40' N, 97°40' E.

Three main expeditions into the interior of the Park were made, viz. 1) to the high mountain blang area (c. 2700 m) of Mt Bandahara (top not reached); 2) to Mt Ketambe (c. 2400 m); 3) to Mt Ketambe and proceeding further towards an unnamed ridge (c. 2800 m) in the

Photograph 1. View over the Leuser Park to the North-West from the upper West slopes of Mt Bandahara with the Mt Leuser- Mt Pucuk Angasan complex in the distance. At the left trees of the coniferous *Dacrydium* cf. *beccarii*, in the centre tall *Pinus merkusii* trees on a ridge emerging from the cloud layer at c. 2000 m altitude.

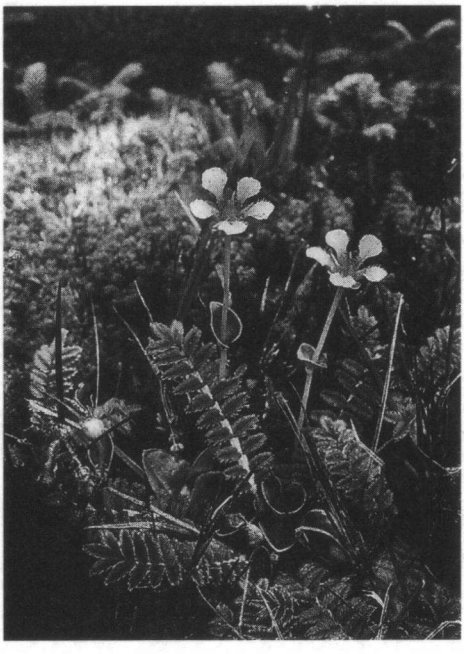
Photograph 2. Part of the extensive mountain blang areas below the Mt Leuser Central top (3400 m, seen in the distance). The low vegetation consists of *Agrostis rigidula, Eriocaulon, Potentilla,* dwarf *Rhododendrons* (e.g. *R. acidophyllum, R. vanderbiltianum*), *Vaccinium,* and *Xyris,* at c. 2750 m alt.



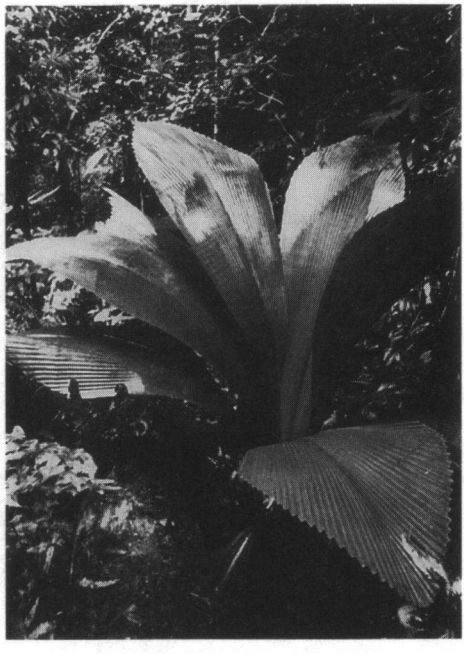
Photograph 1

Photograph 2

Photograph 3



Photograph 4



Photograph 5

interior to the West in the direction of Mt Simpali. The intermediate time was mainly spent with an inventory of Ketambe and vicinity. Total amount of herbarium numbers collected: 2460; nos. 12000–14460.

1. Tour to Mount Bandahara top area; 16–28 June

Actual summit not reached. Total numbers collected 583; nos. 12868–13450; Fig. 3

Starting from Seldok (Lau Penangelan on the main road, c. 250 m); climbing steep ridge in NE direction through ladang area, then entering dense foothill- and submontane forest; (bivouac at c. 700 m; water could only be obtained by digging a deep hole); climbing steep densely forested ridge with collecting at 700–1200 m in dense high-stemmed submontane (ridge) forest and in mossy forest; proceeding in about the same direction NE over ridges with submontane (ridge) forest (c. 1400 m); following steep undulating ridge with damp forested depression with peaty soil, damp mossy forest, mossy stunted forest on ridges, and open mossy ericoid scrub (1400–1900 m); through dense mossy forest on undulating steep ridge with some deep depressions, mossy montane forest, tall montane forest, stunted mossy forest and ericoid forest, with many *Ericaceae* (c. 2000 m); gradually ascending through mossy forest and scrub to open ridge with ericoid mountain scrub (2200–2500 m); over ridges with low mossy forest and ericoid scrub and through depressions with mossy forest and with deep flat depression with tall moist mountain forest traversed by a rivulet draining the large mountain blang area (c. 2500 m; reached June 23); exploring the large blang plateau, which consists of a mosaic of low heath-like vegetation, either dry or wet, intermixed with thickets, of low scrub and forest, mostly on the hillocks; here and there with small meandering brooklets not rarely passing underground in the peaty areas (Photographs 2, 3); this foggy plateau situated at 2600–2700 m stretches SW of the proper Bandahara top-zone; the Bandahara top chain consists of several peaks and is separated by a forested depression of several hundred metres deep (which was explored in 1975, see there); June 25 descending the mountain passing ridges with mossy scrub and low-statured mossy montane forest (2500–2300 m); further descending on the main ridge with mossy montane forest (approximately 1800 m); descending to c. 1000 m, passing (damp) montane forest with a patch of open mossy blang on stony ground; June 28 back to Ketambe via Seldok, descending over the main ridge through lower montane forest (foot hill forest) at 900–300 m.

Photograph 3. The extensive mountain blang area in the top-zone of the Mt Leuser complex, at about halfway the Central top and the West top (in the distance). Low blang vegetation on peaty soil mainly is *Eriocaulon, Potentilla,* and *Xyris*; in the background low subalpine forest with *Gordonia, Ilex, Leptospermum, Quercus,* on the slopes low scrub-dry blang mosaic, e.g. with *Rhododendron sumatranum* at c. 2800 m altitude.

Photograph 4. White-flowering *Parnassia* aff. *wightiana* (from the Himalaya region) was found sporadically on wet places with *Sphagnum* over peat soil with moving ground water. Only known from the Mt Leuser top area at 2800–3000 m. The cordate leaves are of *Parnassia,* the pinnate leaves of *Potentilla borneensis.*

Photograph 5. The magnificent ground palm *Johannesteysmannia altifrons,* in places commonly scattered in primary well-drained lowland forest of undulating land in the Sekundur Forest Reserve (Besitang River area). These plants soon suffer from sunshine and drought when the forest is laid open by logging operations.

2. Tour to Mount Ketambe; 15–20 July

A rugged limestone mountain ridge of c. 2400 m W of Ketambe; total numbers collected 237; nos. 13609–13845

Following the Ketambe River upstream, collecting in riverside forest on rocky bottom (350–500 m); at the bifurcation (simpang) climbing the steep ridge towards the West with colline ridge forest and scattered limestone blocks (500–1000 m); proceeding on the same ridge up to c. 1700 m with flat wet peaty area; collecting in mossy montane forest and in shaded shallow pools on a broad ridge, in montane forest, and while climbing the limestone summit crest of Mt Ketambe (c. 2400 m) reaching c. 1900 m alt. (July 17–20), collecting in forest on limestone, on shaded limestone rock faces, and in scrub; descending back to Ketambe along the same ridge as when climbing up.

3. Second Mount Ketambe expedition; 3–19 August

Mount Ketambe is a limestone mountain c. 2400 m high and projecting towards an unnamed mountain ridge (c. 2700 m) to the South-West in the direction of Mt Simpali. This was an exhausting 17 days long tour, during which nine different field camps were used (Fig. 3). The objectives, viz. a more thorough screening of the limestone vegetation of Mt Ketambe and reaching one of the high mountains (3000 m or more) towards the South-West were not fully achieved. The climbing of Mt Ketambe appeared to be dangerous because of enormous eroded dolomite limestone blocks. With much effort an altitude of only c. 2300 m could be reached. The high mountain in the interior of the Park to the West, presumably Mt Simpali, could not be reached because of continuous rainy and misty weather conditions, the lack of maps, and the rugged terrain with very dense mossy forest. On August 13 a ridge of c. 2500 m was reached at, but a deep transverse trench prevented further progress; altogether 418 herbarium numbers were collected, nos. 13960–14377 (Fig. 3).

Following the lower Ketambe River upstream (see July 15), collecting at 400–500 m mainly in rocky riverside forest; ascending the ridge at the bifurcation (simpang) through colline and lower montane ridge forest (500–1700 m), reaching flattish area with peaty forest at c. 1700 m; botanizing in montane forest on undulating terrain and entering the eastern spur of the limestone summit area of Mt Ketambe, collecting in montane forest (partly on quartzite ground), mossy forest on shaded limestone rocks, and in open forest on limestone (1750–1850 m); collecting in the limestone forest near the summit of Mt Ketambe (reached c. 2350 m) and proceeding through a deep depression of the mountain ridge with deeply shaded forest rich in *Musaceae, Urticaceae, Zingiberaceae* (c. 1700 m), collecting in limestone forest, dense damp montane depression forest (with scattered quartzite rock blocks), gully forest, also along a brooklet and in ridge forest (1700–2300 m); then following a ridge with mossy forest and scrub, reaching c. 2250 m some 15 km WSW from Ketambe; collecting in montane forest, in open mossy forest on rather flat ground (2000–2500 m), in dense and open low mossy forest, and in open low scrub on ridges, forest along a brooklet, and in stunted ridge forest with scattered emergent *Dacrydium* (not collected); proceeding towards SW, traversing mossy forest and scrub area at c. 2100 m with taller mossy mountain forest in depressions, then through rather tall upper montane forest, mossy forest, and on forested ridge; collecting at 2000–2500 m, nos. 14239–14275 (August 12–13), incl. many *Ericaceae* and *Orchidaceae*; descending along same trail, col-

lecting at 2000–2200 m in damp tall montane forest in depressions, also along small streams, at c. 1650 m collecting in montane (mossy) forest with small stream, in montane scrub, in low ericoid scrub on exposed ridges, and on scattered rocks in the forest, also climbing a spur of Mt Ketambe (locally called Gunung Batu-Batu Besar) with open forest on limestone at 1800–1900 m, reaching Ketambe 19 August.

REPORT FOR 1975

The total sojourn in the Leuser area in 1975 again with the base camp at Ketambe research station lasted from January 30 to May 23.

The activities were: 1) 18 Feb.–5 March, a second climbing of Mt Bandahara (a continuation of the expedition of 1972 during which the actual summit was not reached); 2) 30 March–17 April, the climbing of Mt Leuser (the first since Van Steenis' ascent in 1937, and Vanderbilt's in 1939); and 3) 5–17 May, a tour into the interior of the western part of the Park in an effort to climb a high mountain named Mt Mamas (however, only a foothill of c. 2850 m altitude was reached). All three expeditions were seriously hampered by bad weather conditions with much fog and rain preventing sight. During the intervening time collecting was performed in the lowland forest at and in the vicinity of the Ketambe research station largely at 300–500 m altitude and during some minor preliminary excursions the route in the direction of the Mt Mamas, SW of the Ketambe station, was explored; collecting up to 1500 m. Most expeditions were attended by the zoologist Van Strien.

Total amount of collecting numbers 2517 (nos. 14461–16978). See also Jacobs (1976) and Jacobs & De Wilde (1976).

1. Second Mount Bandahara expedition; 19 Feb.–5 Mar. — Fig. 4

Total numbers of collections: 593; nos. 14870–15463

Starting from the village of Lau Penangelan (= Seldok) on the main road, SE of Ketambe (Fig. 3). For the greater part the same trails as in 1972 were followed; this time, on the ninth day the triangulation top pillar (3012 m) was reached after passing a deep ravine two days before the actual climbing of the summit crest. This has seven tops; the pillar is on the central one. Remnants of bivouacs and traces of cutting by the topographer Clements in the early thirties were found on several places.

February 19 — Ascending through sawahs and gardens, then through old and recently damaged colline and lower mountain forest (400–1300 m), proceeding through various types of mountain forest locally with much rattan-thickets and scattered tall old *Pinus merkusii,* passing the same small open blang with low, ericoid vegetation and narrow crest (with *Gunnera* growing along the path) as seen in 1972 (1800–2000 m) (Photograph 1), passing much mossy scrub with in the depressions low mossy mountain forest, and over the large Bandahara blang plateau, c. 7 km NE of Seldok, at c. (2450–)2500–2700 m, comprising dry blang, wet blang, with meandering rivulets, and blang thicket; then direction Bandahara top ridge; with extensive collecting in various blang habitats and thickets at c. 2500–2700 m; passing through a deep depression of c. 200 m with taller mossy forest, a small deeply cut stream at the bottom, and ascending in thicket-dry blang mosaic area close to the Bandahara summit crest, all during continuous heavy rains (Camp 6); follow-

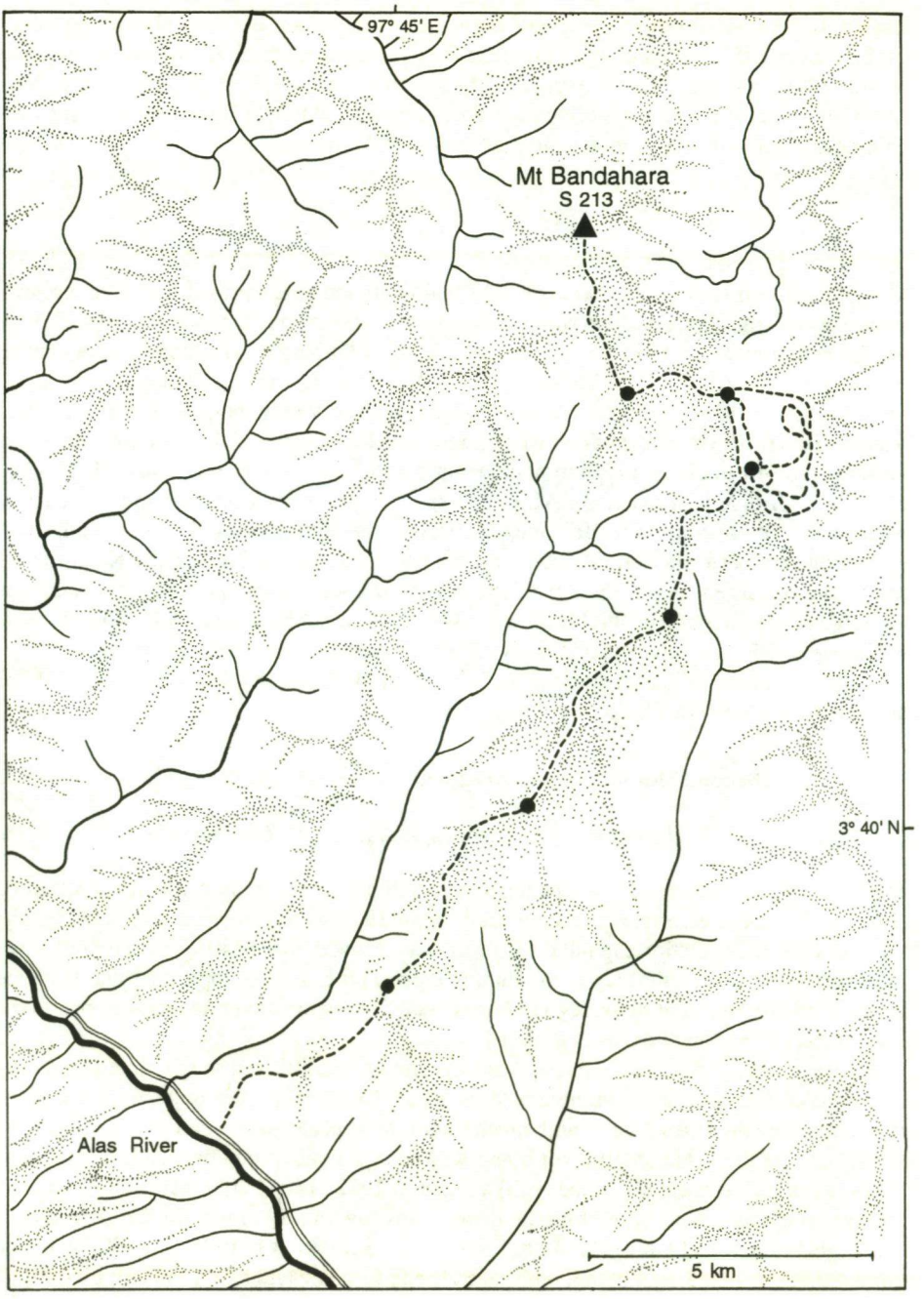


Fig. 4. Route map of the Bandahara expedition, Feb. 19–March 5, 1975. The dots indicate camps; the distance between two camps usually was that as traversed during one day, which means about half a day effectively walking. The winding tracks pertain to exploration trips on the large Bandahara blang area at about 2600–2800 metres.

ing various rather sinuous ridges, ascending through tall and low scrub to the Bandahara summit crest with (5–)7 tops, the summit pillar S 213 (constructed by Clements in the early thirties) at 3012 m on the central top (*February 27*). There are large and small dry and wet blang areas, low scrub, mossy scrub, and damp mossy forest in the depressions; descending while passing the large main blang through various types of scrub and low mossy forest as well as small open blang patches, damp tall mossy mountain forest in depression at 2300–2500 m, and on blang with scattered stunted trees and damp mossy forest patches at c. 2500 m (cold night, 5°C), further descending through tall mossy forest with a rivulet in depression (2400–2500 m) and with mossy thickets and scrub on the ridges, and wet and dry blang terrains at the same altitudes; descending to Seldok traversing damp mountainous forest in places rich in rattan at c. 1850–2000 m, the montane forest at 1500–1800(–1900) m rich in *Castanopsis, Lauraceae, Lithocarpus, Quercus,* and with scattered tall *Pinus merkusii*; proceeding downwards over broad ridge to the main road at Seldok.

March 22–25 — Third Mt Mamas pre-expedition: In order to facilitate the later climbing of Mt Mamas in the inner western part of the Park WSW of Ketambe (see 5 May). The trail followed was the same as that of 7 Feb.; traversing various sorts of mountain forest partly on dolomite (limestone) rock, reaching c. 1800 m.

2. Mount Leuser expedition; 30 Mar.–17 Apr. — Fig. 5

Total numbers of botanical collections 559; nos. 15892–16451

By jeep from Ketambe station in about 8 hours to Blangkejeren, c. 70 km, passing the villages Meluak, Gumpang, Kongke, the watershed at Agusan at 1200 m, with view of the upper Alas valley, then descending to Blangkejeren at c. 900 m, there staying the night. The next day by jeep and by walking (9 km mainly in western direction) to the village of Penosan, c. 1100 m, there distribution of the 'barang' (baggage) among the carriers and the same day proceeding into the mountains. During this tour the Mt Leuser West top, 3440 m, was climbed. The pillar, like that on Mt Bandahara also built by Clements in 1937, was reached the tenth day; most days progress was hampered by rainy and foggy weather. The route was largely the same as that of Van Steenis' expedition in 1937 and Vanderbilt's (mostly zoological) tour in 1939. April 15 back in Penosan, and the same day proceeding to Blangkejeren, back in Ketambe April 17 at dusk (Fig. 3; Photographs 2, 3).

March 31 — Ascending through sawah-land, dry grassy lowland blang (with scattered *Pinus merkusii*), belukar (low secondary wilderness), and ladangs (temporary gardens) to a mountain ladang with a small stream at the forest edge at c. 1500 m, where staying overnight. It appeared that the forest edge ('pintu rimba') had considerably shifted upwards because of ladangs when compared with the overall situation as described by Van Steenis (1938). In his time there was a sharp forest edge as a result of burning. We entered the forest on a steep upwards sloping ridge, with humid mountain forest on ridges at (1500–2000) m; then following a steep ridge with low-statured ridge forest, brushwood and ericoid scrub, with an area of open, formerly burnt ground with peaty soil at c. 2410 m, i.e., the same place where the 1937 expedition had a bivouac; continuing along a narrow trail through mossy forest steep upwards, reaching the first wet and dry mountain blang areas of Mt Pucuk Angasan (c. 2700 m, pillar T 3356), the same day proceeding over a broad ridge with ericoid scrub and stunted forest and patches of open blang to the West, descending through partly mossy mountain forest in a damp depression at c. 2610 m ('Mud-Camp',

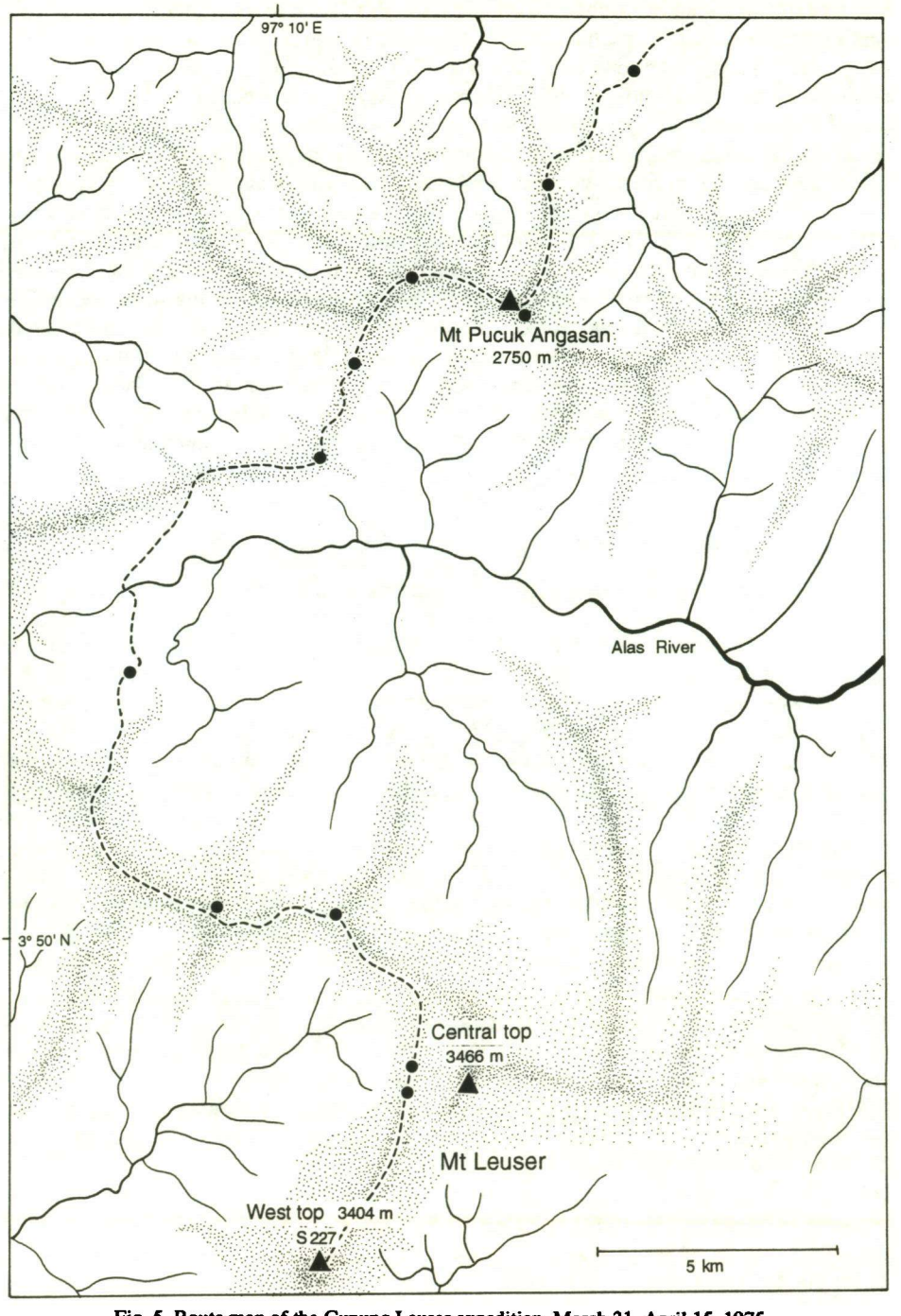


Fig. 5. Route map of the Gunung Leuser expedition, March 31–April 15, 1975.
For further explanation see Fig. 4.

formerly also used by Scheepens, Van Steenis, and Vanderbilt); passing on over many slopes, depressions, and ridges with high montane forest and mossy forest, later on following the ridges of the watershed to c. 2500 m with dense mossy tall shrub on the ridge; traversing mossy forest and smaller and larger patches of open blang, entering the very extensive blang area at 2100–2300 m through which the upper Alas River streams, collecting in rather tall riverine upper mountain forest; crossing the Alas River at 2130 m (Camp Blangbeke with Vanderbilt, see De Schauensee & Ripley, 1940) in the low forest edge; taking the ridge of the long spur upwards, proceeding through various types of mossy scrub and elfin forest to an open spacious flat place with dry and rather wet short blang vegetation, the old site of Van Steenis' 'Neus'-Bivouac, also with remnants of Vanderbilt's expedition among which a rusty iron-and-cement grilling stove! at 2700 m; following a rather narrow ridge, later on curving in SE direction, passing low montane mossy forest and elfin forest and much ericoid scrub, settling Camp 7 during continuous rains on a slightly sloping small wet blang area in low scrub-blang mosaic, again at c. 2750 m altitude; proceeding on the same ridge now curving slightly southward and ascending, passing scrub-blang mosaic terrains of the dry and wet type, dense scrub, low mossy forest in depressions and dense forest along rivulet; collecting at 2750–3150 m; again proceeding through various sorts of low or tall scrub vegetation, or low montane (mossy) forest, or small or large dry or wet blang areas in the direction of the Leuser central summit (Photographs 2, 3), passing an extensive largely wet blang area (with *Parnassia* cf. *wightiana,* Photograph 4), with a meandering rivulet at 2950–3200 m below the Leuser Central top, then following the route over a gentle slope and over ridges with alternating tall ericoid scrub, dry blang, and stony slopes, and traversing a sloping strip with wet blang with moving ground-water, locally with scattered *Parnassia,* settling the farthest field bivouac, Camp 9, on a rather wide plateau in a depression with short scrub and dry blang at c. 3200 m just in view of the gently sloping plateau to the Leuser West top (*8 April*); staying over one day with a day-trip to the summit of Mt Leuser West top, collecting in various types of dry stony blang areas and scrub, and in blang with scattered stunted trees (e.g. *Gordonia* cf. *vulcanica*) at 3200–3400(–3420) m; following back the same trail as when ascending, again collecting in very damp depression with small stream ('Krung Baru'), the same place as where Van Steenis collected in 1937, collecting on the large Alas-blang at 2200–2400 m (e.g. with *Patersonia lowii*), and in the riverine forest there passing the upper Alas River, and in the riverbed on exposed places at c. 2150 m, and again on the blang N of the river; then entering the forest again and proceeding downwards on the existing trail, down via 'Mud-Camp' and Mt Pucuk Angasan (2700 m), reaching Penosan and Blangkejeren in late afternoon *April 15,* traveling back to Ketambe, *17 April,* collecting on the way on sloping gravelly sandstone roadside SE of Kongke at c. 800 m a beautiful gesneraceous herb with bright lilac-blue flowers and whitish felty leaves, *Paraboea paniculata,* a rare species originally described from Malaya.

3. Mount Mamas expedition; 5–17 May — Fig. 6

Total numbers of collections 372; nos 16580–16951

The goal was to reach a high mountain situated about WSW of Ketambe of more than 3000 m height. The route followed was more southern than the expedition into the interior of 1972. Only a forerunner of about 2850 m height with on its broadly sloping shoulder some patchy

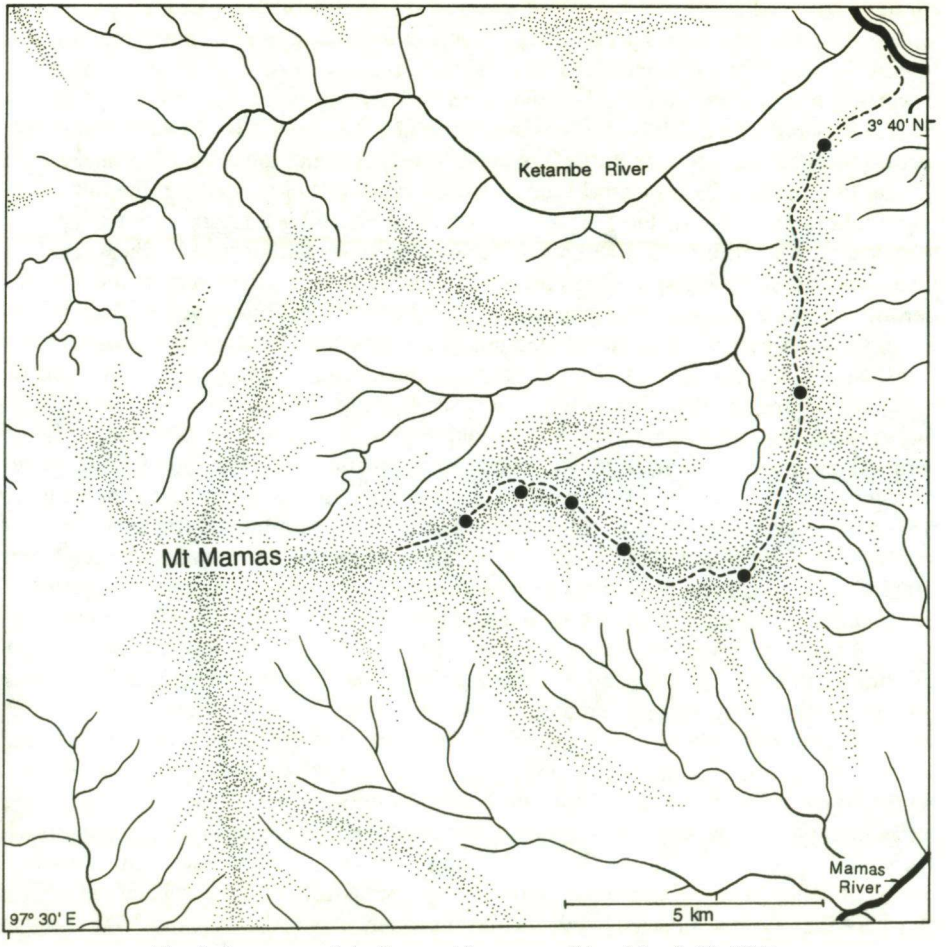


Fig. 6. Route map of the Gunung Mamas expedition, May 5–17, 1975.
For further explanation see Fig. 4.

blang areas could be reached. Mt Mamas remained invisible and hidden by mist and rain (see route map, Fig. 3). Starting by foot from Ketambe station, first following for a short time the Alas River downstream, then penetrating into the interior of the Park, climbing the ridge previously followed on pre-expeditions (see before) with at about 600 m a groove of tall clump bamboo, higher on the ridge some unknown trees with enormous stilt-root systems and a few arm-thick rattans, collecting in colline-, lower-, and mid-mountain forest (typical for stony screes is a stunted cf. *Cynometra* spec.), and in mossy forest with peaty soil in the flatter areas, reaching c. 1150 m; proceeding through various types of montane forest, tall montane scrub, and shrubby mossy forest to c. 1500 m; following old rhinoceros trails over broad ridges, slopes, and contra-slopes with montane mossy forest, at 1600–1700 m the forest is extremely thin (elfin forest), damp and mossy, and rich in *Sphagnum* on the bottom, here and there with *Eriocaulon*, the trees at a rough estimate for thirty per-

cent consisting of *Dacrydium*; then proceeding mainly in western direction, repeatedly ascending and descending through extremely difficult and unsurveyable terrain with dense mossy forest, mossy tall open scrub, sometimes crossing a small stream, or locally at c. 1950 m marshy mountain forest. On *May 9* a distinct broad ridge in the direction of a forerunner of Mt Mamas was followed with mossy forest, higher up on the ridge-crests changing into a low dry scrub, ascending to c. 2600 m, passing small marshy open places, descending to 2350 m where Camp 5 was established in open shrubby montane forest with non-flowering *Rhododendron atjehense*; exploring mossy forest, depression forest along a small stream (collecting *Anemone sumatrana, Arisaema, Begonia,* and *Carex*), climbing towards a sub-top at c. 2600 m with shrubby open forest rich in *Ainsliaea* (mostly sterile), *Scirpus subcapitatus, Sphagnum,* and *Swertia.*

May 13 — Settling in Camp 7 at c. 2650 m, the farthest bivouac of this expedition probably situated about 10 km SW of the Ketambe station; collecting in a variety of subalpine habitats including mossy forest, open and shaded subalpine marshland (with moving groundwater), and along a small stream in boggy ericoid blang with *Sphagnum*; descending into a deep depression, then ascending in various types of very mossy forest at c. 2700 m changing into dense tall as well as low, mossy scrub, reaching c. 2850 m (with e.g. *Kobresia kobresioides, Pyrola sumatrana*), finally entering a broad flattish saddle (running presumably in the direction of Mt Mamas) with several patches of dry and wet boggy blang areas, some with small scattered pools with clear brownish water with *Sphagnum, Xyris,* etc. growing along the fringe; a possible route to Mt Mamas could not be found due to lack of sight because of continuous dense fog, heavy rains, and almost impassable dense mossy jungle; back at Ketambe 17 May.

REPORT FOR 1979

The 1979 mission to Indonesia lasted from 27 May to 18 August; the actual stay in the study area in northern Sumatra from June 8 to August 13.

The base camp was again at Ketambe (8 June) where the working facilities had been greatly augmented by the recently built field station which was officially opened on July 24. Final departure from Ketambe 30 July after which we settled in the Sekundur Forest Reserve (Upper Besitang River), 2–9 August for a survey of the lowland forest.

Contrary to the explorations of 1972 and 1975 when high mountains were climbed this time emphasis was on inventory of forests at lower altitudes. Besides this incidental collecting was done in the forests on the foothills surrounding Ketambe and especially in the valley of the nearby Guhra River (a tributary of the Alas River). In the valley are hot springs. Three major areas of collecting were visited, viz. 1) the upper Mamas River valley in the interior of the western part of the Leuser Reserves at 1200–1800 m, 2a, 2b) two consecutive tours of the lowland forest areas near the southern borders of the Reserves, near the mouths of the Bengkong River and of the Renun River (both tributaries of the Alas River), and 3) exploration of the lowland forests of Sekundur Forest Reserve in the eastern part of the Leuser Reserves NW of Medan.

The total number of collections was 1595 (nos. 18000–19594) (see also Jacobs, 1980).

Starting from Lawe Sigala-gala (c. 250 m, on the main road, SE of Kutacane), crossing the Alas River, and walking in a rather straight line up to the watershed with the topographic pillar at c. 1250 m; proceeding to Camp 'Pawang', one of the semi-permanent working bivouacs established by Van Strien (1978, 1985, also for brief descriptions of the forests in

the area). From this base camp various tours including a 4-day trip to 'Camp Aceh' (Fig. 3) were made in the area. Back to the Alas valley and Ketambe field station on July 1. In total 521 numbers were collected; partly belated numbering, nos. 18202–18395, 18411–18604, 18622–18649, 18983–19109, 19116–19197.

Climbing from the degraded forest edge along the Alas River opposite Lawe Sigala-gala at c. 250 m steeply upwards for about a thousand metres on the West-slope of the Alas valley (topographic pillar at c. 1250 m), passing through primary colline and submontane forest; then roughly towards the NW through various types of submontane and lower montane forest, reaching altitudes of c. 1600 m; collecting in the vicinity of Camp Pawang (c. 1300 m) in rich flat lower and upper montane forest, in the valley with tributaries of the Upper Mamas River with tall montane riverine forest, and in and along a swamp (mainly with *Cyperaceae*) at 1250–1900 m; climbing a ridge to a mountain to the West, collecting at 1400–1800 m in montane forest, 'pole' forest (at c. 1400 m), mossy forest and mossy scrub rich in *Ericaceae* (at c. 1800 m), and in a small blang area with open vegetation at c. 1800 m, large *Trigonobalanus verticillatus* was locally frequent at c. 1400 m (not collected); returning June 30, descending the steep slope down to the Alas River, reaching the base camp at Ketambe station 1 July.

2a. Reconnaissance tour to the area of the mouth of the Bengkong

July 5–7 — River Muara Bengkong. The Bengkong River is a tributary of the Alas River downstream from the Ketambe station. It flows from the West and forms part of the southern border of the West part of the Leuser Park. This three-day pre-expedition was followed by a longer stay in roughly the same area, 13–22 July, see there (2b).

Starting from Ketambe by jeep to the South, leaving the main road at the village of Lawe Deski, then westward to the bank of the Alas River, from Muara Stulen proceeding downstream by motor prahu. After passing the cataracts making a bivouac at Muara Bengkong close to the rocky escarpments at c. 125 m altitude, a site also frequented by fishermen. Collecting in and behind the forest edge along the Alas River while approaching Muara Bengkong mainly in riverine forest (disturbed in some places), and on the rocky escarpment partly basaltic or sandstone (with *Pentastemona sumatrana*), in plateau forest at Muara Bengkong, in forest 3–10 m above the river, at c. 125 m altitude.

2b. Second Muara Bengkong expedition; 13–22 July

The same route as on 5–7 July was followed, but in addition we also stayed in a bivouac near the mouth of the Renun River a few kilometres upstream on the Alas River from Muara Bengkong. Collecting in riverine and plateau forest, also climbing some mountain-slopes, one of which to a height of about 500 m. The Renun River drains a part of the Karo plateau East of the Alas River. Near the mouth of the Renun River a fairly extended grassy plain sharply bordered from the surrounding forest was discovered and botanized. This plain with tall grasses and herbs obviously of old age and apparently perpetuated by regularly burning carried a surprisingly rich flora.

July 13–17 — Base camp at Muara Bengkong, exploring forest on undulating land and on low hills (300 m), riverine forest along the Alas, basaltic scree forest, and the plateau-

forest on rich loamy soil over basaltic rock West of the Alas River just South of Muara Bengkong; at 100–150 m; these forests are rich in *Annonaceae,* we also saw *Amorphophallus* spec., *Araceae* spec. with large withering leaves, *Mapania* spec., and *Knema hookeriana,* but *Knema furfuracea* which was found in nearby ridge-forest on much poorer soil was not seen here. These well-developed tall forests on rich soils at c. 100 m partly outside the Park were being cleared for cash-crops and commercially logged over in recent times; replacing base camp to a bivouac on the East bank of the Alas River close to the mouth of the Renun River (Muara Renun) a tributary streaming from the East (*July 19*) where we stayed for three nights. Collecting in primary alluvial and terrace forest of the Alas River, rich in *Annonaceae,* situated c. 3 m above the mean water-level at c. 100 m altitude, and in the foothills up to 300 m in forest on basalt-derived soils; exploring an area of several tens of hectares of tall grassy savanna. This grassy savanna at c. 100 m was sharply marked off from the surrounding forest and was obviously of anthropogenous origin perpetuated by regular burning in dry periods. It was located just South of the mouth of the Renun River in the angle with the Alas River. The herb layer consisted predominantly of 50–100 cm tall grasses mixed with a rich flora of other herbs (e.g. *Curculigo orchioides, Exacum tetragonum, Stackhousia intermedia*), soil was sandy most likely basalt-derived.

3. Exploration in the Sekundur Forest Reserve; 3–9 August

The Sekundur Forest Reserve belongs to the Leuser Park and is situated at the Eastside NW of Medan. Sekundur is the name of a low mountain nearby (c. 1800 m) and the forest reserve mainly consists of lowland and subcolline forest at 50–500 m altitude. The base camp was in a lodge used by the Park guardians in the upper Besitang River area. At the time parts of the forest were logged-over, sometimes to a large extent. In many places the lowland forest on yellow or reddish 'lateritic' clay soil is rich in *Johannesteysmannia altifrons* (Photograph 5), a low, stemless palm with beautiful broad-elliptical entire leaves. In logged-over areas this palm was obviously much suffering from insolation and desiccation as was testified by plants of much lower stature and with yellowish-green instead of green leaves; possibly these palms need a specific mycorrhiza which is damaged by the effects of the logging. Collecting 322 numbers (19273–19594) in the lowland forest area of the NE part of the Sekundur reserve, mainly in primary or recently logged-over forest on undulating land, and some in marshy forest at c. 50 m altitude.

REPORT FOR 1985

In 1985 mainly lowland forest was visited, particularly lowland marshy forest below 50 m altitude.

There were three main areas of exploration, viz. 1) dry land, riverine and marshy forest along the lower Lembang River (which forms the northern boundary of the Kluet partial reserve, West Coast); 2) forests along the middle Alas River (Lae Sauraya) S of Muara Bengkong just S of the Park (see also the 1979-mission); and 3) dry land and freshwater marshy- and peat swamp forest along the Lae Batu-Batu, a tributary streaming from the East into the lower Alas River, in the area N of Singkil (Simpang Kiri River area) which was in places logged-over. Parts of this latter area have been proposed as an addition to the Park, as these would add valuable lowland marshy forest as a habitat to the Leuser Park.

Botanical collecting in marshy forest required special provisions, because these terrains usually are only accessible with small boats that follow the often badly marked and strongly meandering creeks. Bivouacs could only be made on the low sandy levees (riverbanks) from which the marshy forest could be penetrated wading through the muddy soil or clambering over the aerial roots of the trees.

The total stay in Indonesia lasted from June 11 to August 18; effective botanical work in the area started June 28 and ended August 9.

The number of herbarium-collections made was 1302 (nos. 19595–20896).

1. Lembang River expedition: 30 June–18 July

Total numbers of collections 453; nos. 19595–20069, 20832–20896 (belated numbering)

June 29 — Departure from Tapaktuan (West Coast of Aceh) to Kandang (some 20 km to the SE). The next day setting out from Lembang (at the mouth of the Lembang River or Krung Lembang some kilometers SE of Kandang) in two prahus following the Lembang River through marshy forest, finally reaching a dry land foot-hill forest E of Pucuk Lembang.

The Lembang River is a narrow, slow-streaming, strongly meandering river and forms the northern borderline of the so-named Kluët partial reserve. The latter is situated to the West of the Park as a rather elongated outlier towards the West Coast. It stretches through the western coastal plain with open marshland and freshwater marshy forest, lying largely almost at sea level. The Kluët forest area is the only true lowland forest of the Park below c. 50 m above sea level.

The Lembang River is formed by brooks originating in the western outrunners of the central mountains of the Park, and where the river enters the lowland plain the locally broad river valley is populated by man. This cultivated area with as its main village (kampung) Pucuk Lembang forms an enclave in the Park and can be reached by a footpath from the NW. This path leads from the densely populated plain with rice-fields along the lower Kluët River crossing a low watershed.

After having traversed the cultivated kampung area of Pucuk Lembang the Lembang River continues downstream strongly winding through the coastal plain with marshy forest. The river debauches in a coastal lagoon with the minute kampung Krung Lembang lying alongside some 20 km SE of Tapaktuan. The lagoon largely consists of an extensive plain with rough shrubby marshland (in places with extensive *Nipa* palm vegetations) and is separated from the sea by a low sandy shore-wall (with scattered *Pandanus* grooves).

June 30 — Leaving kampung Krung Lembang in two prahus going up-stream. Passing through secondary and heavily logged-out forest especially at the left hand side, but also many encroachments (with active tree felling, ladangs) were seen in the reserved part of the forest. Bivouacs were made on the river bank in riverine (levee) forest at c. 5–10 m altitude and three days were spent to explore in various types of nearby lowland forest: riverine forest, marshy forest, levee forest, and on low limestone-sandstone hills, up to 250 m. Progress on the river was difficult because of the many dead trees in the water.

The river levee was some 4 or 5 m above the river and consisted of sandy clay. The marshy forest or 'rahwa' lays behind it. At the time, in the dry season, large stretches had fallen dry and the mud soil now covered with fallen dry leaves was exposed, but in places it still was inundated by clear but blue-greyish water. The bottom consisted of a mixture of

very fine sand and bluish clay locally overgrown to some extent with gregarious *Cryptocoryne moehlmannii*. This forest was some 30–40 m high. Behind the bivouac on the edge with the marsh forest were two huge strangling fig trees (*Ficus* spec.). Along the river was a narrow belt of dense prickly low vegetation of a slender rattan, possibly *Calamus* (19655), of which the local people say that it never flowers. In the foothills scattered spiny-stemmed palms (cf. *Oncosperma*) were found. In the riverine forest tall lianeous *Alsomitra* with large globose green fruit (not collected) was frequent.

July 7 — Proceeding by foot along the river, then crossing hilly terrain, finally following an indistinct trail bordering marshy forest rich in cf. *Phrynium* to reach a path leading to the plain of the village Pucuk Lembang. Two base camps were used upstream from the village on the river bank across the upper Lembang River not far from the Park border. In the background forested limestone hills were rising up to c. 500 m, farther away rising still more steeply, and higher up, almost vertically. The cliffs here and there whitish because of the limestone with little vegetation could not be reached. In the valley coffee (*Coffea*) and nilam (*Pogostemon*) were cultivated as cashcrops. At all sides tall forest rises up on the steep slopes partly on limestone with limestone precipices seen upstream in the distance, but below there is a wide stretch of flat humid riverside forest. In places its vegetation is reminiscent of that of the Ketambe research area, only here it is at a lower altitude, about 50(–80) m. Two species of 'latong', shrubby *Urticaceae* with stinging leaves, are common around the camps, also there are stands of wild bananas (*Musa* spec.), but the fruit is small and full of blackish grains, hence not edible.

July 15 — Leaving the area by way of the foot path to the North over the watershed, traversing the extensive plain with wet rice fields of the lower Kluët River valley, back to Kandang, that same day reaching Tapaktuan late at night.

July 18 — Leaving Tapaktuan for Gelombang on the Alas River.

The village Gelombang is situated where the main road crosses the lower Alas River which is here rather slow-streaming and has a considerable width. It has originated from an old logging camp centre and vast areas in its surroundings are depleted of forest.

At the site where the Kluët Reserve touches the Ocean there is a narrow sandy shore with *Casuarina* beach forest with behind the shore wall wet grassy plains and marshes grazed by kerbou (water buffaloes). More to the interior of the reserve are various types of marshy scrub and (secondary) forest. The sandy shore wall is rather broad, in places with small undulating dunes. The estuaries of a number of small rivers sometimes form shallow lagoons usually bordered with *Nipa* palm, or more inland with extensive stands of tall *Hanguana malayana*. The low forest bordering the sea belongs to the *Barringtonia* formation with frequent *Barringtonia asiatica, Casuarina, Scaevola, Terminalia,* and some other characteristic species.

2. Lae Sauraya exploration tour; 19–28 July

Total numbers of collections 307; nos 20106–20412

Lae Sauraya is the local name for the middle part of the Alas River. The explored area lies outside Leuser Park some 50 km South of the area of Muara Bengkong which was visited in 1979 (see there). At the time rafts of logs frequently descended the river indicating that logging in the Bengkong area was going on. In this area the river is strongly meandering

(Fig. 3) and there were numerous used or abandoned ladangs in the fringing forest. The river bank was generally rather high, some 2–3 m, with a fringing belt of *Saccharum spontaneum*, or in most places with a narrow belt of riverine forest passing into foothill forest or plateau forest at 50–100 m altitude, the forest ascending much higher on to the mountains at various distances. At several places small streams enter the main river, some falling over the escarpment. Base rock is basalt and sandstone. The largest river joining the Lae Sauraya in this area is the Lae Sebelin, a considerable subsidiary river, entering from the Karo Plateau in the East. At its mouth a few kilometers N of our base camp a small Batak settlement of a few houses has been recently established. Here started a narrow foot trail over the plateau forest to the East grossly following the river.

The base camp was on a barren ladang at c. 50 m alt., c. 15 km upstream from Gelombang, on the bank with a fringe of tall *Saccharum spontaneum* and with dense forest at the back. The forest appeared particularly rich in *Annonaceae* and *Euphorbiaceae*.

Among the most interesting plants found in this area were *Biophytum adianthoides*, a rheophyte, and *Pentastemona sumatrana*, the type species of the *Pentastemonaceae*, of which a population also occurred just inside the Park at Muara Bengkong.

28 July–9 Aug. — This stay was mainly used to take an inventory of freshwater marshy forest and dryland forest along the Lae Batu-Batu.

Base camp was made on the South bank at a place called Belintang near the logging bridge (c. 15 m altitude). On the way up strongly devastated transmigration areas were seen and later on extensive logging premises and camps. Near our bivouac a wide logging road had been constructed by means of thousands of transversely placed logs crossing a wide stretch of marshy forest and shallow peat swamp forest. These forests were relatively easily accessible because of the dry season which normally lasts to the beginning of September. In this area 390 numbers were collected (nos 20413–20802), in freshwater marshy forest, (shallow) peat swamp forest at c. 15 m altitude, and in dry land rich mixed dipterocarp forest on rolling ground at 30–60 m.

Near the camp the river is slow-streaming and rather narrow, its bed some 20–40 m wide, meandering through the marsh forest in between its sandy levees which are situated some 3–4 m above the river. Its water was clear and of a light brown colour. The marsh forest was about 30 m tall; its bottom consisted mainly of weak mud soil with pneumatophores of various types all around. There were many types of epiphytes, including mosses. Common ground herbs were *Cryptocoryne moehlmannii, Hydrostemma, Lasia spinosa,* and *Scirpodendron ghaeri*. A rather slender *Licuala* palm was frequently seen here.

The dry land forest was logged for *Dryobalanops aromatica*. Members of *Sapotaceae*, mainly *Madhuca* spec., appeared locally abundant and at the time were flowering profusely with a strong scent of sweet condensed milk. One of the interesting finds was *Gymnacranthera bancana*, locally frequent, and new for northern Sumatra.

It became evident that these types of forest, although in the vicinity of the Park, do not exist within the Park borders proper.

REPORT FOR 1991

The 1991 mission to N Sumatra was mainly to the Sekundur Forest Reserve situated at the East side of the Park to sample within the scope of the N.C.I. Frederick, MD/Chicago plant screening programme. This area was previously visited in 1979, see there.

July 19–Aug. 14 — The base camp was at an abandoned PHPA-premise near the entrance of the Sekundur Forest Reserve at Aras Napal on the Besitang River not far from the (now overgrown and abandoned) base camp of the exploration of 1979 of the same area.

Collecting was performed in various types of lowland forest at 50–100 m altitude within the Reserves, i.e. in alluvial forest, at Aras Napal, in various types of dry land mixed dipterocarp forest on undulating land, in riverside forests in the reaches of the upper Besitang River (Prov. of N Sumatra), as well as at Trengganu (Aceh) at c. 100 m altitude.

Large parts of the Reserves had been logged over some 10–15 years ago, but the beautiful ground palm *Johannesteysmannia altifrons* (no. 21118) appeared still quite frequent in some places growing on shady well-drained slopes (Photograph 5). However, large stretches of forest with this palm had been turned into oil palm estates or small-holder citrus plantations in this area. Tall palms of presumably *Orania sylvicola* were found scattered in the forest south of Aras Napal at the edge of the Park. This site also harboured the beautiful ground herb *Acrotrema costatum*, in northern Sumatra only known from a few localities.

In the upper Besitang River stands of the rheophytes *Biophytum adianthoides* and *Pandanus dorystigma* were noteworthy.

In total 327 herbarium numbers (nos. 21083–21411, with duplicates) were assembled, of which about 90 as vouchers for the N.C.I. sampling.

August 16/17 · A short tour to the Alas valley was made, subsequently a trip by motor prahu on the Alas River, starting from Muara Stulen to Gelombang, in order to visit the two known localities of *Pentastemona sumatrana*, viz. at Muara Bengkong (see report for 1985) and at the mouth of the Sebelin River. Both endeavours were successful. Some living plants and pickled material were collected for greenhouse culture and morphological study, respectively.

August 20/21 — A short visit was paid to Bukit Lawang (Bohorok) and a foothill with partly logged-over forest on limestone situated some 10 km S of Bohorok was briefly inspected. Apparently these forests have a special floristic composition but to assert this more extensive collecting and floristic analysis is still necessary.

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