

Pteridophytes of Northern Sumatra

— A Report of Botanical Trip in 1971 —

by

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The pteridophytes of Sumatra are far less explored compared with those of Malaya or Java. This is more evident in Northern Sumatra where collections are very sparse especially for the pteridophytes. Mr. J. A. Lörzing stayed in Sibolangit and collected a number of specimens around there including many pteridophytes, and several botanists have been in Berastagi and collected specimens there, including Dr. R. E. Holttum who was there in 1924. Wide areas of the southeastern part of Sumatera Utara or the region around Medan is cultivated for rubber, oil palm, sugar cane, and many other field crops, and the forests around Danau Toba were destroyed for cultivation. In contrast to this, the inland areas of Aceh, Gayoland, is covered by dense forest and has hardly been botanized as yet except by the two extensive expeditions by Dr. C. G. G. J. van Steenis in 1937 and 1939. The collections from Northern Sumatra are mostly kept in BO, K, L and SING.

As part of my floristic research on the Southeast Asian pteridophytes, I visited the Malay Peninsula in 1966 and 1967. I have collected at Khao Luang and Khao Chong in Thailand in 1966, and in some localities in Penang, Cameron Highlands, around Kuala Lumpur and in Johore in Malaya as well as on Khao Luang in 1967. The vegetation and flora of Malaya are quite similar to those of Peninsular Thailand, and I was interested to compare them with those of Northern Sumatra which is placed just opposite to Malaya.

I had a chance to visit Northern Sumatra during August and September of 1971 by the courtesy of the Center for Southeast Asian Studies, Kyoto University. I was accompanied by two botanists, Professor M. Hirano and Mr. G. Murata, and joined by Dr. J. Dransfield and his assistant, Mr. Didin Saerudin, at Bogor. The botanical trip to Northern Sumatra was, thus, made by Indonesian, British and Japanese participants with the endorsement of the Lembaga Ilmu Pengetahuan Indonesia (LIPI). The Sumatran trip was carried out by the above five members between 10 August and 9 September, 1971.

The following account is the record of this trip with special reference to the pteridophyte collections. The lists of the pteridophytes collected in this Northern Sumatra trip in 1971 are given according to the place, in some cases with more details of the habitats concerned.

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The identification is rather preliminary, and further investigation is necessary for many species. The purpose of this paper is to give an outline of the pteridophytes of Northern Sumatra in order to help elucidate the phytogeography of the pteridophytes in Southeast Asia. The data in this paper is again discussed in another paper concerning the phytogeography of the pteridophytes of Peninsular Thailand (Iwatsuki, 1973). More than 7,000 specimens were collected in this trip and about 1,800 in field numbers, among them the pteridophytes consist of some 300 species. Some of the specimens were preidentified by Dr. M. Tagawa, though I have verified all the determinations, and the responsibility for all the identification is due to the author in spite of their preliminary condition. Mr. M. Kato helped me in identifying the specimens of the Athyriaceae. The order of the species in each enumeration is in accordance with the system of M. Tagawa & K. Iwatsuki (1972).

In the lists of the collection in this paper, all the species of the pteridophytes end with the field number of each corresponding specimen with prefix S-. The collectors of all the specimens cited are K. Iwatsuki, G. Murata, J. Dransfield and D. Saerudin. The first complete set of the specimens is in KYO and the first duplicate set is in BO. The third set goes to L, the fourth and fifth to K and TI, and the sixth rather irregular set of the pteridophytes is in US. We have still a number of specimens unidentified, and they are to be noted in a further publication.

I Sibolangit and Danau Toba

Arriving at Medan on 10 August, we completed various preparations necessary for the trip in Northern Sumatra within that day. Following our advance request the Consulate

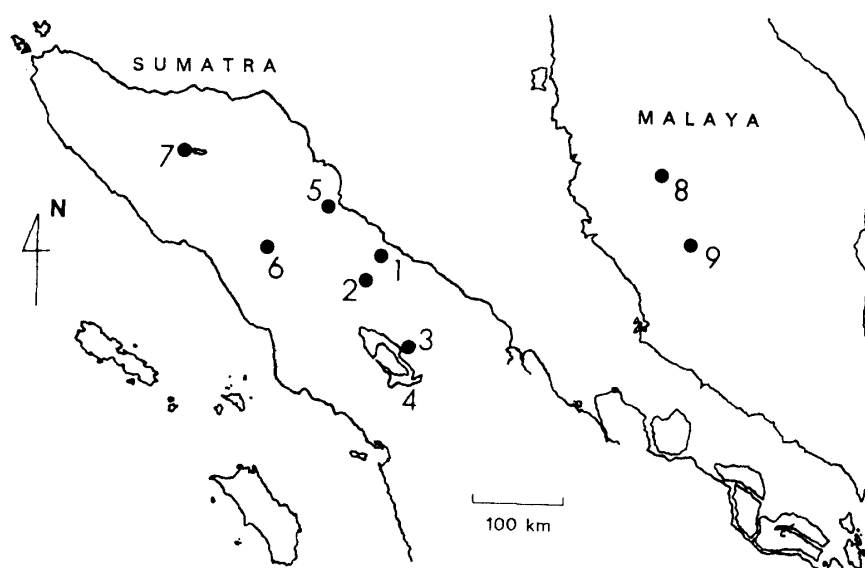


Fig. 1 A map of Northern Sumatra and Malaya. 1, Medan; 2, Sibolangit; 3, Prapat; 4, Danau Toba; 5, Besitang; 6, Gunung Kemiri; 7, Takeun; 8, Cameron Highlands; 9, Fraser's Hill.

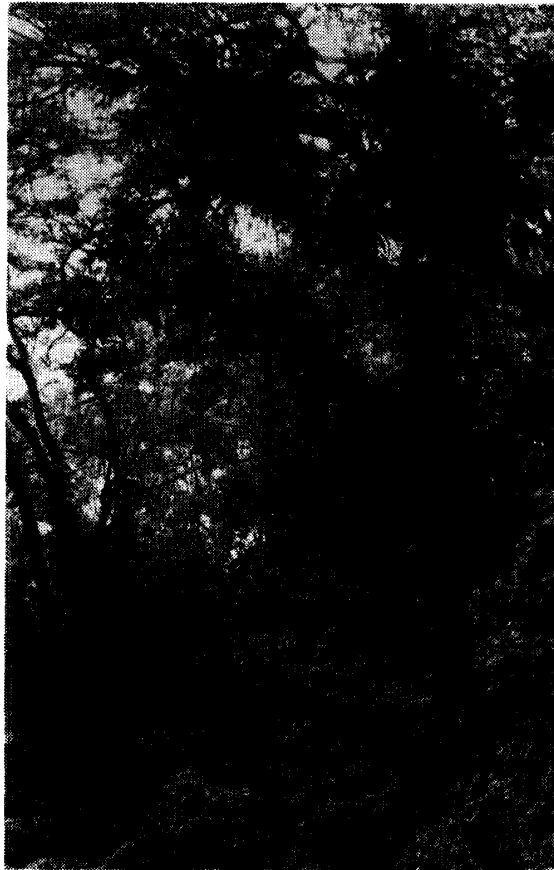


Photo. 1 Sibolangit (photo by G. Murata)

of Japan was most helpful in asking Japex Indonesia Ltd. to arrange a comfortable jeep with a driver for our trip. This jeep with the driver, Mr. Manan Lubis, was used by us throughout this Sumatran trip, and was most helpful in our botanical research. The Forest Department was also very helpful to us preparing the arrangement for the Sikundar, Besitang, trip for 13–15 August and other excursions, and sent Mr. Simanjuntak, assistant from the Department of Nature Conservation, with us during 11–15 August.

We left Medan in the early morning of 11 August for Sibolangit, and worked at first just below the Botanical Garden there. This is in the forest at 400–450 m alt., and there are such pteridophytes as

Selaginella ciliaris (Retz.) Spring S-11, *S. mayeri* Hieron. S-12 and *Thelypteris arida* (Don) Morton S-10

in open places along the road, and in shade

Selaginella padangensis Hieron. S-101, *Angiopteris palmiformis* (Cav.) C. Chr. S-83, *Christensenia aesculifolia* (Blume) Maxon S-93, *Asplenium unilaterale* Lam. S-92, *Tectaria angulata* (Willd.) Copel. S-88, *T. sp. aff. T. malayensis* (Christ) Copel. S-86, *Heterogonium giganteum* (Blume) Holtt. s. lat. S-91, *Thelypteris truncata* (Poir.) K. Iwats. S-90 and *Diplazium pallidum* (Blume) Moore S-76.

After botanizing for a few hours in this forest on the way, we proceeded to the Botanical

Garden at Sibolangit on the hill top at about 450 m alt. Sibolangit was made famous by the active collection by Mr. J. A. Lörzing, formerly the Director there. This Botanical Garden is partly a Nature Reserve, and a variety of the wild plants are available in the Garden which is in a rather beautiful state of neglect. There is a trail from the office into the forest, and at the entrance of the Garden there are tall trees on which are various larger epiphytes such as

Davallia solida (Forst.) Sw. S-96, *Vittaria ensiformis* Sw. S-80, *Asplenium affine* Sw. S-79, *Dryopteris subarborea* (Baker) C. Chr. S-74 and *Polypodium subauriculatum* Blume S-73.

This has a lush tropical appearance, and the forest inside is quite dense and includes various species of pteridophytes as epiphytes or in the undergrowth. The species except for those cited above are

Selaginella mayeri Hieron. S-82, *Crepidomanes bipunctatum* (Poir.) Copel. S-81, S-99, *Antrophyum callifolium* Blume S-85, *A. parvulum* Blume S-100, *Tectaria melanocaulon* (Blume) Copel. S-94, *Heterogonium subglabratum* Holtt. S-89, *H. sagenioides* (Mett.) Holtt. S-98, *Thelypteris heterocarpa* (Blume) Morton S-78, *T. megaphylla* (Mett.) K. Iwats. S-87, *Diplazium petiolare* Presl S-75, S-77, *D. polypodioides* Blume S-95, *Microsorium nigrescens* (Blume) Copel. S-97 and *Loxogramme avenia* (Blume) Presl S-84.

We left Sibolangit in the afternoon, and drove to Prapat, collecting several species on the way near Kabenjahe, at about 1,200 m from sea level. The pteridophytes collected on the way from Sibolangit to Prapat are all terrestrial in open places along the road side and are

Pteridium aquilinum var. *wightianum* (Ag.) Tryon S-111, *Sphenomeris chinensis* (L.) Maxon S-110, *Thelypteris unita* (L.) Morton S-112 and *Crypsinus trilobus* (Houtt.) Copel. S-109.



Photo. 2 Along Danau Toba, with *Dicranopteris curranii* (photo by G. Murata)

On the next day, 12 August, we drove from Prapat to about 40 km southeast along Danau Toba, and found there a very interesting marsh. This is a Sphagnum bog several hundred meters from the lake and is about 1,200 m in altitude. There was a wide variety of flowering plants, and the pteridophytes collected there were

Lycopodium cernuum L. S-157, *Nephrolepis biserrata* (Sw.) Schott S-173, *Thelypteris confluens* (Thunb.) Morton S-155, *T. callosa* (Blume) K. Iwats. S-154, *T. sp.* S-153, *Athyrium sp.* S-149, S-156, *Microsorium commutatum* (Blume) Copel. S-174, *M. rubidum* (Kunze) Copel. S-238, *Polypodium subauriculatum* Blume S-172, and on the branch of bush in this marsh is *Pyrrosia winkleri* (Rosenst.) Tagawa S-168.

In the afternoon of that day, we drove back from this area to Medan, collecting in various places on the way. There are various habitats there, open place along road, light shade in secondary forest, rocks in open places or in light shade, along streams or wet ground by ponds, steep slopes in shade, or along the road through the villages. The altitude is between 800–1,200 m, except for one place in an oil-palm plantation at about 400 m alt. where we collected a specimen of *Vittaria ensiformis* Sw. S-228. The pteridophytes collected in the Prapat area are

Lycopodium serratum Thunb. S-217, *Selaginella mayeri* Hieron. S-235, *Equisetum debile* Roxb. S-216, *Lygodium microphyllum* (Cav.) C. Chr. S-232, *Dicranopteris curranii* Copel. S-175, *Cyathea contaminans* (Wall. ex Hook.) Copel. S-227, *Sphenomeris chinensis* (L.) Maxon S-231, *Tapeinidium pinnatum* (Cav.) C. Chr. S-236, *Davallia denticulata* (Burm.) Mett. S-230, *Pityrogramma calomelanos* (L.) Link S-229, *Pteris vittata* L. S-234, *Blechnum orientale* L. S-171, S-214, *Dryopteris sp. aff. D. sparsa* (Don) O. Ktze. S-169, *Thelypteris megaphylla* (Mett.) K. Iwats. S-170, *T. cuspidata* (Blume) K. Iwats. S-237, *T. torresiana* (Gaud.) Alston S-233 and *Dipteris conjugata* Reinw. S-215.

II Sikundar

During the period 13–15 August, we made a short excursion to Sikundar area in the Langkat Nature Reserve. This trip was arranged by Mr. R. J. Bangun Mulja, the Chief of the Department of Nature Conservation, Divisional Forestry Department at Medan, and Rimba Jaya Ltd., a local timber company, was helpful in offering us facilities in travelling, accommodation, transportation and so on. Sikundar is situated inland from Besitang, near Tanjungpura, at the northeastern edge of Sumatera Utara, and is a part of the Langkat Nature Reserve. Amidst the vast area of this Nature Reserve, covering 200,000 ha, a concession has been given to Rimba Jaya to collect timber in an area of about 5,000 ha for 15 years after 1963. The logging company has two comfortable cottages in the midst of the felling area, some 20 km from Besitang, and they kindly offered us facilities to stay there without charge for two nights.

In the morning of 13 August we drove from Medan to Besitang and waited there for a few hours for the rising tide, as we were told that the most convenient way to arrive at

the cottage in Sikundar was by boat. The tide was, however, already on the ebb, and we had to change the way to the land route. While we were at Besitang and while the timber company had discussed how to take us to the cottage, we worked in *Nypa* swamp along the road under strong sunshine and collected several species of plants including such ferns as *Lygodium microphyllum* (Cav.) C. Chr. S-287, *Nephrolepis biserrata* (Sw.) Schott S-288 and *Acrostichum aureum* L. S-289.

There are tall trees along the road in some places and the epiphytic ferns growing on the trunks of such trees in the shade of the crown, included

Vittaria ensiformis Sw. S-271, *Stenochlaena palustris* (Blume) Bedd. S-269, *Pyrrosia adnascens* (Forst.) Ching S-261 and *Drynaria quercifolia* (L.) J. Smith S-262.

In a paddy field along road, we collected sterile plants referable to *Marsilea crenata* Presl S-263.

After a drive on a terrible track for a short while, we arrived at the cottage of Rimba Jaya at about 100 m alt. in the late afternoon. Before dusk, we worked around the cottage, and collected several species in recent clearings or along streams in shade. The pteridophytes are

Lycopodium cernuum L. S-307, *Selaginella roxburghii* (Hook. & Grev.) Spring S-321, *Dicranopteris linearis* var. *subspeciosa* Holtt. S-293, *Cephalomanes javanicum* (Blume) v. d. Bosch S-291, *Taenitis blechnoides* (Willd.) Sw. S-300, *Blechnum finlaysonianum* Hook. & Grev. S-303, *Thelypteris arida* (Don) Morton S-292 bis, *T. polycarpa* (Blume) K. Iwats. S-292 and *Diplazium tomentosum* Blume S-322.

On the second day in Sikundar, 14 August, we proceeded by a lorry to the cottage about 3 km further inland from the first one. Leaving that second camp in the morning, we walked through the cleared area to the primary forest. There is little variation in altitude on the trail, i.e. between 100–250 m above sea level. The important timber of this rich lowland forest was cut down recently by Rimba Jaya, although there were various habitats available for both the epiphytic and terrestrial plants. It was rather convenient to collect the epiphytes, as there were many trees cut down with epiphytes still living in the upper portions of them. The epiphytic pteridophytes collected on that day are

Lycopodium carinatum Desv. S-367, *L. phlegmaria* L. S-354, *Meringium denticulatum* (Sw.) Copel. S-355, *M. spp.* S-356, S-357, *Lindsaea parasitica* (Roxb. ex Griff.) Hieron. S-363, *Asplenium phyllitidis* Don S-361, *Pyrrosia* sp. S-360, *Selliguea heterocarpa* Blume S-359 and *Ctenopteris moultoni* (Copel.) Holtt. S-353.

There were terrestrial species on the moderate slope in light or deep shade such as

Selaginella intermedia (Blume) Spring S-346, *S. roxburghii* (Hook. & Grev.) Spring S-344, *Cyathea glabra* (Blume) Copel. S-366, *C. moluccana* R. Br. ex Desv. S-369, *Taenitis blechnoides* (Willd.) Sw. S-343, S-352, *Pityrogramma calomelanos* (L.) Link S-371, *Thelypteris chlamydophora* (Rosenst.) Ching S-348, S-368 and *Diplazium crenato-ser-ratum* (Blume) Moore S-347.

Several shade ferns were collected along streamlets usually on muddy rocks or sandy ground. They are

Mecodium polyanthos (Sw.) Copel. S-357 bis, *Meringium denticulatum* (Sw.) Copel. S-351, *Gonocormus saxifragoides* (Presl) v. d. Bosch S-357 ter, *Selenodesmium obscurum* (Blume) Copel. S-358, *Lindsaea ensifolia* Sw. S-345, *Syngramma alismifolia* (Presl) J. Smith S-349, S-387 and *Pyrrosia sparsisora* (Desv.) Moore S-350.

There are two stream-side specimens not yet identified: one should be a new variety of *Lindsaea ensifolia* Sw. S-362, and the other an abnormal plant belonging to the genus *Syngramma* S-388.

Most of these species were found only in restricted areas, and it was rather difficult to gather many individuals of each species, though we could often find after a walk of another few hundreds meters species not yet collected on that day. In this kind of lowland forest, the habitat seems to be strictly limited for each species, or many species have been damaged by the recent change of the forest. We cannot make any ecological analysis of this interesting lowland forest, and give here only the floristic enumeration of the pteridophytes.

Finally we arrived at the primary forest, where the tall trees stand densely not allowing sufficient light for undergrowth. We could not collect any particular ferns there, and left there after a few minutes walk.

In the morning of the last day in Sikundar, 15 August, we made additional collections around the second cottage. It was interesting to find *Acrostichum aureum* L. S-423 in such an inland habitat, on wet ground along a streamlet. No tidal influence could be found there, and it was unlikely that anyone had brought this fern to this particular place. The other ferns collected there were those usually found in open or marshy places and all with wide distribution areas, such as

Lygodium flexuosum (L.) Sw. S-422, *Microlepia speluncae* (L.) Moore S-421, *Nephrolepis radicans* (Burm.) Kuhn S-417, *Ceratopteris thalictroides* (L.) Brongn. S-415, *Stenochlaena palustris* (Blume) Bedd. S-432 and *Thelypteris goggilodus* (Schkuhr) Small S-436.

On the way back from the second cottage to Besitang, we made frequent stops and collected a variety of pteridophytes along the trail through recent clearings. The species collected are

Selaginella willdenowii (Desv.) Baker S-413, *Pteridium aquilinum* var. *yarrabense* Domin S-416, *Nephrolepis hirsutula* (Forst.) Presl S-418, *Pteris tripartita* Sw. S-433, *Blechnum orientale* L. 419, *Thelypteris unita* (L.) Morton S-434, *T. polycarpa* (Blume) K. Iwats. S-414 and *Diplazium crenato-serratum* (Blume) Moore S-435.

III Gunung Kemiri

The main purpose of our Sumatran trip in 1971 was to botanize in Gayoland, Aceh. There are several peaks higher than 3,000 m in this area, but they have hardly been explored

botanically except for the comprehensive expeditions by Dr. van Steenis in 1937 and 1939. In Bogor we could not get sufficient information about Gayoland, and they knew very little even in Medan. At the Forest Department in Medan, they could only suggest we visited the Local Forestry Office at Kotacane.

We were rather busy on 16 August preparing the collections of 11–15 August and arranging the luggage for the trip to Gayoland. We could not expect to work on the next day, for it was the National Holiday of Indonesian Independence. We had a good holiday on that celebrated day, and left Medan in the early morning of 18 August.

After a long drive with all the camping equipment and food stuffs on our jeep, we arrived at Kotacane in the evening of that day and visited the Forestry Office first. We had a long talk before we decided to explore Gunung Kemiri from Kampung Geumpang. The Chief of the Local Forestry Office at Kotacane, Mr. M. Bustami Nepala, was quite helpful to us in various ways. In the morning of the next day, he brought us to the Regional Military Office, Regional Police Office and to the Local Governmental Office to complete the registration necessary for all foreigners. In the afternoon, he accompanied us to Kampung Geumpang; we drove along a just jeepable road through dense primary and secondary forest. We collected at a few spots on the way; one fern collected was a specimen of *Microsorium nigrescens* (Blume) Copel. S-573. We arrived Geumpang in the late afternoon and Mr. Bustami Nepala helped us to make the arrangements for the Gunung Kemiri trip for one week. We discussed with the Chief of Kampung Geumpang and his elder brother, the guide, how to explore the mountain.

On 20 August Dr. Dransfield drove back to Kotacane to prepare some additional materials for the trip, and the Japanese botanists worked along the road through the village. Kampung Geumpang is a small village between Kotacane and Blangkejeren, situated at the foot of Gunung Kemiri and along the Sungai Simpang-kiri, and is about 600 m above sea level. There is a narrow flat along the river, and here the villagers cultivate rice and sweet corn, though production seems to be rather poor. They have durian plantations and coconuts are frequent in such inland villages. The population density is rather low in this area, and the vegetation is still in its primary condition except for the cultivated area along the river. Thus the Nature Reserve is not seriously damaged and is in good condition due to the low activity of the people in this area. We collected on that day just along the road, not going inside the dense primary forest.

We met several fallen trees in one place just above the road and collected a variety of epiphytes on the trunk including such pteridophytes as

Lycopodium squarrosum Forst. S-706, *Selaginella frondosa* Warb. S-705, *Mecodium polyanthos* (Sw.) Copel. S-713, *Davallia denticulata* (Burm.) Mett. S-678, *D. divaricata* Blume S-707, S-717, *Humata repens* (L.f.) Diels S-720, S-720 bis, *Antrophyum callifolium* Blume S-715?, S-719, *Asplenium pellucidum* Lam. S-689, *A. squamulatum* Blume S-693, *A. salignum* Blume S-695, *Pyrrosia abbreviata* (Zoll.) Tagawa S-727, *P. penangiana*



Photo. 3 Mountain forest on Gunung Kemiri (photo by G. Murata)

(Hook.) Holtt. S-712, *P. varia* (Kaulf.) Farw. S-716, *Photinopteris acuminata* (Willd.) Morton S-718, *Loxogramme subecostata* (Hook.) C. Chr. S-704, *Crypsinus platyphyllus* (Sw.) Copel. S-728, *Polypodium subauriculatum* Blume S-682 and *Ctenopteris khasyana* (Hook.) Holtt. S-714.

It was quite fruitful to find so many species in a small area, and many other species were observed and collected on that day. There are various habitats along the road in Kampung Geumpang and here they will be distinguished quite roughly into three: terrestrial species on humus rich or clayey ground in open place or in light shade are

Lycopodium cernuum L. S-660, *Selaginella frondosa* Warb. S-725, S-726, *S. padangensis* Hieron. S-710, *Pteridium aquilinum* var. *wightianum* (Ag.) Tryon S-661, *Sphenomeris chinensis* (L.) Maxon S-659, *Nephrolepis biserrata* (Sw.) Schott S-686, *N. hirsutula* (Forst.) Presl S-708, *Pityrogramma calomelanos* (L.) Link S-709, *Blechnum orientale* L. S-658, *Thelypteris multiseta* (Baker) Ching S-702, *T. arida* (Don) Morton S-657, *T. unita* (L.) Morton S-655, *T. dentata* (Forsk.) St. John S-711, *T. polycarpa* (Blume) K. Iwats. S-701, *Diplazium petiolare* Presl S-688 and *D. polypodioides* Blume S-721; those on wet ground or in deep shade are

Equisetum debile Roxb. S-656, *Pteris vittata* L. S-685, *Thelypteris megaphylla* (Mett.) K. Iwats. S-722, S-722 bis, S-723, *Diplazium bantamense* Blume S-697, *D. esculentum* (Retz.) Sw. S-724 and *D. accedens* Blume S-692;

and those on muddy rocks along streams or epiphytic at the base of tree trunks or on the branches of trees in shade are

Crepidomanes bipunctatum (Poir.) Copel. S-687, *Asplenium tenerum* Forst. S-694, *A. macrophyllum* Sw. S-684, *A. squamulatum* Blume S-703, *A. batuense* v. *A. v. Ros.* S-700, *A. sp.* S-681, *Teratophyllum aculeatum* (Blume) Mett. S-690, *Microsorium commutatum* (Blume) Copel. S-683, *M. heterocarpum* (Blume) Ching S-691, *M. zippelii* (Blume) Ching S-696, *M. musifolium* (Blume) Copel. S-699, *Lemmaphyllum accedens* (Blume) Donk S-698, *Belvisia mucronata* (Fée) Copel. S-679 bis and *B. revoluta* (Blume) Copel. S-679 ter, S-680.

We spent one week on Gunung Kemiri (21–27 August). This was quite a successful trip from a botanical point of view, though we met various difficulties on the way. We set our first camp at about 1,000 m alt., the second on a narrow ridge at about 1,600 m alt., the third at about 2,700 m alt. and the fourth and the highest camp just below 3,000 m alt. On the way back we stayed in the third and second camps, and came back to Kampung Geumpang on the seventh day, 27 August.

The vegetation lower than 1,000 m is generally similar to that around the village and the beautiful mountain forest extends over a wide area. The forest there belongs to a type usually called the lowland evergreen forest and there is a variety of species without any particular species dominant. Some noteworthy ferns in this forest are: *Cyathea junghuniana* (Kunze) Copel. S-770 forming thickets less than 1 m in height; *Antrophyum califolium* Blume S-778, S-778 bis, *Vittaria elongata* Sw. S-771, *Asplenium pellucidum* Lam. S-764 and *Polypodium persicifolium* Desv. S-766, S-784 are pendulous bearing long leaves; and *Tectaria* sp. aff. *T. malayensis* (Christ) Copel. S-774 and *Diplazium dilatatum* Blume S-780 form dense undergrowth thickets in moist deep shade. The other pteridophytes collected between 600–1,000 m alt. are

Selaginella kittyae v. *A. v. Ros.* S-763, *Botrychium daucifolium* Wall. ex Hook. & Grev. S-776, *Osmunda javanica* Blume S-788, *Crepidomanes bipunctatum* (Poir.) Copel. S-773, *Cyathea* sp. S-790, *Lindsaea repens* (Bory) Thwaites S-783, *Davallia trichomanoides* Blume S-789, *Nephrolepis falcata* (Cav.) C. Chr. S-785, *Asplenium affine* Sw. S-786, *A. salignum* Blume S-779, *T. tenerum* var. *retusum* C. Chr. S-775, *Pleocnemia hemiteliiformis* (Racib.) Holtt. S-781, *Diplazium crenato-serratum* (Blume) Moore S-775 bis, *D. petiolare* Presl S-772, *D. xyphophyllum* (Baker) C. Chr. S-787, *Microsorium congregatifolium* (v. *A. v. Ros.*) Holtt. S-767, *M. punctatum* (L.) Copel. S-777 and *Loxogramme avenia* (Blume) Presl S-768.

The forest between 1,000–1,800 m alt. is so-called hill evergreen forest or more plainly mountain forest. We passed through dense gloomy forest, observing various habitats of the pteridophytes. The conspicuous species in this forest are: several species of tree ferns forming thickets, such as *Cyathea recommutata* Copel. S-875, *C. lurida* (Blume) Copel. S-987, *C. gigantea* (Wall. ex Hook.) Holtt. S-992, *C. glabra* (Blume) Copel. S-874 and *C.*

persquamulifera (v. A. v. Ros.) Domin S-993; terrestrial *Diplaziums*, especially dominant is *Diplazium sorzogonense* (Presl) Presl S-871 which may be the most abundant species in this zone, and the other terrestrial *Diplaziums* including *D. malaccense* Presl S-845 and various forms of *D. cordifolium* Blume¹⁾; and the species common in this zone and hardly seen in the mossy forest in addition to *D. sorzogonense* are *Selaginella intermedia* (Blume) Spring S-879, *Macroglena meifolia* (Bory) Copel. S-835 and *Ctenopteris curtisii* (Baker) Copel. S-847. The other species in this zone are many in number, and growing in various habitats including epiphytic, on muddy or mossy rocks, terrestrial, in moist places along streams, on humus on slope, in rather dry ground in narrow ridges, in deep shade, to sunny places along the ridge-path, and so on. Here will be enumerated all the other pteridophytes collected between 1,000–1,800 m alt. without any comment on their habitat.

Lycopodium phlegmaria L. S-888, *L. piscium* (Hert.) Tagawa & K. Iwats. S-881, *L. serratum* Thunb. S-889, *Ophioglossum pendulum* L. S-880, S-996, *Osmunda javanica* Blume S-886, *Gleichenia* sp. S-989, *Dicranopteris linearis* var. *tetraphylla* (Rosenst.) Nakai S-984, *Mecodium polyanthos* (Sw.) Copel. S-833, *Meringium* sp. S-830, S-834, *Myriodon brassi* (C. Chr.) Copel. S-829, *Amphipterum fuscum* (Blume) Presl S-837, *Gonocormus saxifragoides* (Presl) van den Bosch S-832, *Vandenboschia latifrons* (v. d. Bosch) Copel. S-831, *V. auriculata* (Blume) Copel. S-836, *Selenodesmium obscurum* (Blume) Copel. S-838, *Cibotium barometz* (L.) J. Smith S-860, *Lindsaea napaea* v. A. v. Ros. S-887, *L. lobata* Poir. ex Lam. S-986, *L. doryphora* Kramer S-858, *L. oblanceolata* v. A. v. Ros. S-839, *L. pulchella* var. *blanda* (Mett. ex Kuhn) Kramer S-991, *Humata pectinata* (Sm.) Desv. S-855, *Oleandra pistillaris* (Sw.) C. Chr. S-997, *Coniogramme fraxinea* (Don) Diels S-1000, *Antrophyum parvulum* Blume S-856, *Vittaria angustifolia* Blume S-848, *V. scolopendrina* (Bory) Thwaites S-863, *Vaginularia paradoxa* (Fée) Mett. S-857, *Pteris venulosa* Blume S-841, *Pteris* sp. aff. *P. rangiferina* Presl ex Miq. S-1004, *Asplenium nidus* L. S-851, *A. phyllitidis* Don S-862, *A. normale* Don S-843, *A. pellucida* Lam. S-843 bis, *A. tenerum* Forst. S-999, *A.* sp. S-840, *Blechnum vestitum* (Blume) Kuhn S-983, *Woodwardia auriculata* Blume S-846, S-988, *Bolbitis heteroclita* (Presl) Ching S-842, *Teratophyllum aculeatum* var. *montanum* Holtt. S-852, *Elaphoglossum subellipticum* Rosenst. S-853, S-853 bis, *E. blumeum* (Fée) J. Smith S-850, *E. callifolium* (Blume) Moore S-849, *Dryopteris* sp. aff. *D. hirtipes* (Blume) O. Ktze. S-884, *D.* sp. aff. *D. sparsa* (Don) O. Ktze. S-990, *Arachniodes hasseltii* (Blume) Ching S-882, *Polystichum tenggerense* Rosenst. S-995, *P.* sp. S-1003, *Thelypteris viscosa* (Baker) Ching S-854,

1) *Diplazium cordifolium* is variable in its leaf structure, and varieties are recognized by the difference in pinnation. We could observe in this zone three forms, var. *cordifolium* S-873 with simple fronds, var. *integrifolium* (Blume) S-865 bearing 1–5 lateral pinnae with cuneate bases and large terminal pinnae, and var. *pariens* (Copel.) C. Chr. S-870 bearing more lateral pinnae with round to subcordate base and smaller terminal pinnae. These differences are usually put down to being due to differences in age, though we could hardly observe the various forms growing side by side. In each colony, generally, the same pattern of pinnation was seen, though this should be tested in cultivation before reaching conclusions.

T. crassifolia (Blume) Ching S-890, *T. toppingii* (Copel.) K. Iwats. S-883, *T. heterocarpa* (Blume) Morton S-994, *Athyrium gedeanum* (Racib.) Christ S-982, *Diplazium subseratum* (Blume) Moore S-884, *D. crenato-serratum* (Blume) Moore S-869, *D. tomentosum* Blume S-872, *D. subintegrum* Holtt. S-985, *D. latisquamatum* Holtt. S-998, *Cheiropleuria bicuspis* (Blume) Presl S-885, *Neocheiropteris normalis* (Blume) Don S-1002, *Belvisia validinervis* (Kunze) Copel. S-1001, *B. callifolia* (Christ) Copel. S-878, *Microsorium heterocarpum* (Blume) Ching S-859, *Crypsinus platyphyllus* (Sw.) Copel. S-877, *C. laciniatus* (Presl) Holtt. S-861, *Acrosorus* sp. S-867, *Ctenopteris brevivenosa* (v. A. v. Ros.) Holtt. S-866, *C. fuscata* (Blume) Kunze S-876, *C. subminuta* (v. A. v. Ros.) Holtt. S-891, *C. contigua* (Forst.) Holtt. S-864 bis and *C. obliquata* (Blume) Copel. S-864.

The aspect of the forest changes rather suddenly at the elevation about 1,800 m from sea level. Beautiful mossy forest develops between 1,800–2,500 m alt., bearing on the mossy tree trunks a variety of epiphytes such as

Lycopodium piscium (Hert.) Tagawa & K. Iwats. S-1034, S-1117, *Mecodium polyanthos* (Sw.) Copel. S-1053, *M. javanicum* (Spr.) Copel. S-1055, *M. crispatum* (Wall. ex Hook. & Grev.) Copel. S-1062, *M. badium* (Hook. & Grev.) Copel. S-1061, S-1066, *Microtrichomanes dichotomum* (Kunze) Copel. S-1057, S-1127, *M. nitidulum* (v. d. Bosch) Copel. S-1056, *M. palmatifidum* (K. Müll.) Copel. S-1059, *Meringium acanthoides* (v. d. Bosch)



Photo. 4 Mossy forest on Gunung Kemiri (photo by G. Murata)

Copel. S-1052, *M. blandum* (Racib.) Copel. S-1065, 1130, *M. holochilum* (v. d. Bosch) Copel. S-1060, *Myriodon brassi* (C. Chr.) Copel. S-1054, *Amphipterum fuscum* (Blume) Presl S-1063, *Pleuromanes pallidum* (Blume) Presl S-1058, S-1064, *Vittaria angustifolia* Blume S-1032 bis, *V. malayensis* Holtt. S-1032, *Asplenium nidus* var. *musifolium* (J. Smith) Bedd. S-1009, *A. caudatum* Forst. S-1015, S-1115, *Asplenium* spp. S-1020, S-1122, *Elaphoglossum subellipticum* Rosenst. S-1022, *E.* spp. S-1118, S-1120, S-1121, *Lemmaphyllum rostratum* (Bedd.) Tagawa s. lat. S-1028, S-1119, *Belvisia revoluta* (Blume) Copel. S-1033, *B. validinervis* (Kunze) Copel. S-1027, *Loxogramme malayana* Copel. S-1029, *Crypsinus triquetrus* (Blume) Copel. S-1031, *C.* sp. S-1026, *Selliguea lima* (v. A. v. Ros.) Holtt. S-1068, *Scleroglossum pusillum* (Blume) v. A. v. Ros. S-1042, *Acrosorus* sp. S-1035, *C. mollicoma* (Nees & Blume) Kunze S-1044, *C. fuscata* (Blume) Kunze S-1046, S-1132, *C. subminuta* (v. A. v. Ros.) Holtt. S-1045, *C. curtisii* (Baker) Copel. S-1036,²⁾ *C. obliquata* (Blume) Copel. S-1048, *C. contigua* (Forst.) Holtt. S-1043, *C.* sp. S-1037, 1135, *Xiphopteris subpinnatifida* (Blume) Copel. S-1050, S-1134, *Grammitis setosa* Blume S-1038, S-1047, S-1133, *G.* sp. aff. *G. hirtella* (Blume) Tuyama S-1039, *G.* sp. S-1133 bis and '*Polypodium subdichotomum* Racib.' S-1041.

The terrestrial species of ferns are also different to some extent from those in hill evergreen forest, and those collected on the humus rich ground in dense gloomy forest are

Macroglena meifolia (Bory) Copel. S-1131,²⁾ *M. gemmata* (J. Smith) Copel. S-1131 bis, *Cyathea oinops* Hassk. S-1008, *Monachosorum subdigitatum* (Blume) Kuhn S-1011, S-1128, *Asplenium normale* Don S-1113, *Blechnum patersoni* (R. Br.) Mett. S-1010, *B. fraseri* (A. Cumm.) Luer. S-1014, *Acrophorus nodosus* Presl S-1013, 1129, *Diacalpe aspidioides* Blume S-1006, *Thelypteris viscosa* (Baker) Ching S-1007, S-1012, *T. truncata* (Poir.) K. Iwats. S-1114, *Stegnogramma aspidioides* Blume S-1016, *Athyrium puncticaule* (Blume) Moore S-1030, S-1123 and *A. anisopterum* Christ S-1019.

There are several other species known in the same altitudinal zone but in different habitats: those on clayey ground usually at or just below ridges in open places or in light shade are *Plagiogyria glauca* (Blume) Mett. S-1025, S-1124, *P. pycnophylla* (Kunze) Mett. S-1018, *P. tuberculata* Copel. S-1067, *Pteridium aquilinum* var. *wightianum* (Ag.) Tryon S-1112 and *Dipteris conjugata* Reinw. S-1111; *Gonocormus saxifragoides* (Presl) v. d. Bosch S-1051, *G. siamensis* Tagawa & K. Iwats. S-1051 bis and *Grammitis fasciata* Blume S-1032, S-1125 were found on moist rocks in deep shade; and *Thelypteris badia* (v. A. v. Ros.) Ching S-1021, S-1126 and *Ctenopteris tenuisecta* (Blume) J. Smith S-1049, S-1116 were found at the base of tree trunks in dense forest.

The general aspect of the mossy forest on Gunung Kemiri is similar to that on mountains in the Malay Peninsula with many species in common. The tree trunks seem to be more than twice their diameter, surrounded by the mosses among which grow various species

2) These two species are typical of mountain forest but quite rare in mossy forest, though we collected them in the latter forest type as exceptional specimens.

of the filmy ferns as well as grammitids. In the Malay Peninsula the mossy forest extends usually above 1,500 m alt. or only around the summit on smaller mountains, and the highest peak is only 2,190 m in the Malay Peninsula. I have never been on this highest mountain, Gunung Tahan, but I have made collections on Khao Luang (1,786 m) and Khao Chong (ca. 1,300 m) in Peninsular Thailand and on Cameron Highlands (2,031 m) and Fraser's Hill (1,457 m) in Malaya. Compared with the mossy forests in the Malay Peninsula, that on Gunung Kemiri is much more dense, gloomy, moist and richer in both epiphytic and terrestrial species.

In the Malay Peninsula the mossy Forest covers the highest peaks of mountains except for the area around the peak. In contrast to this, in the Gayolands, Ericoid forest is developed on ridges at elevations higher than 2,500 m. The most part of this zone on Gunung Kemiri is said not to be quite natural, as there was a big fire there in 1937. We observed there a few tree trunks with black carbonized surfaces still standing. The pteridophytes collected in this zone are

Lycopodium clavatum L. S-1161, *L. cernuum* L. S-1227, *L. cernuum* var. *vulcanicum* (Blume) Adelb. S-1124, S-1138, *Plagiogyria tuberculata* Copel. S-1137, S-1140, S-1154, *Gleichenia vulcanica* Blume S-1156, *Paesia radula* (Baker) C. Chr. S-1155, *Humata vestita* (Blume) Moore S-1139, S-1151 and *Crypsinus triquetrus* (Blume) Copel. S-1165. The ridges have a few undulation and small streamlets can be found in hollows where dense forest can be found even at such high elevations. In such forest we collected such pteridophytes as

Lycopodium sp. S-1024, *Meringium* sp. S-1226, *Microtrichomanes dichotomum* (Kunze) Copel. S-1163 bis, *M. palmatifidum* (K. Müll.) Copel. S-1163, *Dryopteris subarborea*



Photo. 5 Ericoid forest at ridge of Gunung Kemiri

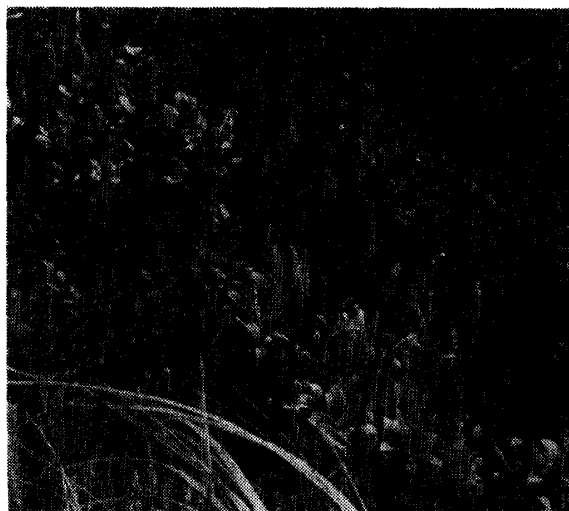


Photo. 6 *Gleichenia vulcanica* on Gunung Kemiri



Photo. 7 Highland marsh on Gunung Kemiri

(Baker) C. Chr. S-1159, *Ctenitis adnata* (Blume) Ching S-1160, *Athyrium anisopterum* Christ S-1158, *Belvisia validinervis* (Kunze) Copel. S-1157, *Crypsinus* sp. S-1164, *Acrosorus* sp. S-1162, *Calymmodon cucullatus* (Nees & Blume) Presl S-1162 bis, *Ctenopteris fuscata* (Blume) Kunze S-1153 and C. sp. S-1152, *Xiphopteris hieronymusii* (C. Chr.) Holtt. S-1162 bis and *Grammitis* sp. S-1150.

As one would expect there are not so many species at the higher elevations on rather dry sandy or clayey slopes in the Ericoid forest. On and below the ridge at elevations higher than 2,500 m, there is a wide expanse of Ericoid forest. At an elevation of about 3,000 m, there is no dense forest even in hollows on wet ground. So-called highland marsh is found in such places, and there are various herbaceous flowers of temperate affinity, including *Potentilla*, *Gentiana* and *Lobelia*. Some Lycopods were found there such as

Lycopodium carolinianum L. S-1271, *L. selago* L. S-1284 and *L. wightianum* Wall. ex Grev. & Hook. S-1225.

We did not reach the very summit of Gunung Kemiri, for we considered it fruitless

to walk on another full day along the same kind of ridge top through dense Ericoid forest. We do not know, therefore, Gunung Kemiri above 3,000 m above sea level.

On the way back from Kampung Geumpang to Medan we stayed one night at Berastagi and took two full days having frequent stops on the way, though this was still insufficient considering the richness of the flora there. *Thelypteris immersa* (Blume) Ching S-585 was collected along stream near a hot spring about 10 km from Geumpang. Long stems of *Psilotum complanatum* Sw. S-589 and *Lycopodium squarrosum* Forest. S-577 were both more than 1 meter long on a tall tree trunk en route from the hot spring to Kotacane.

We visited the hot springs, Lau Debukdebuk, near Berastagi, though few species of the ferns were found there. *Histiopteris incisa* (Thunb.) J. Smith S-495 is known from hot springs in Japan, and this is true also in Northern Sumatra. *Ceratopteris thalictroides* (L.) Brongn. S-494 was found in a paddy field, and *Vaginularia paradoxa* (Fée) Mett. S-497 and *Dryopteris* sp. aff. *D. sparsa* (Don) O. Ktze. S-491 were collected in the Berastagi area. Completing a short fruitful botanical trip to the Gayolands, we came back to Medan on 29 August with our jeep more than full with luggage.

IV Takegeun

After a busy stay on 30 August in Medan arranging the luggage and preparing for the next trip, we left there in the early morning of 31 August. It took one full day to drive from Medan to Bireuën along the main road in northeastern Sumatra, for we made several stops on the way to botanize in various habitats, in open grassy places, in mangrove thickets, or in thin forest. The ferns were not particularly rich in number of species; those collected on that day are

Lygodium microphyllum (Cav.) C. Chr. S-1346, *Microsorium scolopendria* (Burm.) Copel. S-1293 and *Drymoglossum piloselloides* (L.) Presl S-1349.

On 1 September we drove from Bireuën to Takegeun with a few stops on the way. As we wished to be in Takegeun within office hours, we did not botanize particularly thoroughly on the way and we planned to spend a full day there on the way back. After working for two days in the Takegeun area, we botanized en route from Takegeun to Bireuën on 4 September, observing various habitats on the way. The pteridophytes collected on 1 and 4 September are

Selaginella alutacea Spring S-1779 bis, *S. frondosa* Warb. S-1767, S-1774, S-1779, *S. kittyae* v. A. v. Ros. S-1762, *S. mayeri* Hieron. S-1698, *S. plana* (Desv.) Hieron. S-1634, S-1686, *S. wallichii* (Hook. & Grev.) Spring S-1645, *S. wilddenowii* (Desv.) Baker S-1642, *Dicranopteris linearis* var. *subspeciosum* Holtt. S-1641, *Lygodium flexuosum* (L.) Sw. S-1695, *Vandenboschia maxima* (Blume) Copel. S-1766, *Cyathea gigantea* (Wall. ex Hook.) Holtt. S-1693, *Lindsaea odorata* Roxb. S-1685, *L. cultrata* (Willd.) Sw. S-1643, *Tapeinidium pinnatum* (Cav.) C. Chr. S-1636, S-1684, *Davallia divaricata* Blume S-1770, *Davallodes viscidulum* (Mett.) v. A. v. Ros. S-1761, *Nephrolepis hirsutula* (Forst.) Presl S-

1632, *Taenitis vittarioides* Holtt. S-1644, *Antrophyum vittarioides* var. *majus* v. A. v. Ros. S-1778, *Pteris silvatica* v. A. v. Ros. S-1692, *P. tripartita* Sw. S-1781, *Asplenium decorum* Kunze S-1773, *A. obscurum* Blume S-1765, *A. salignum* Blume S-1780, *Lomagramma sumatrana* v. A. v. Ros. S-1763, *Arachniodes* sp. S-1689, *Ctenitis mannii* (Hope) Ching S-1639, *C. vilis* (Kunze) Ching S-1687, *Tectaria angulata* (Willd.) Copel. S-1635, *T. melanocaulon* (Blume) Copel. S-1691, *T. ternifolia* (v. A. v. Ros.) C. Chr. S-1699, *Heterogonium giganteum* (Blume) Holtt. S-1764, *Thelypteris malayensis* (C. Chr.) Reed S-1638, S-1688, *T. heterocarpa* (Blume) Morton S-1633, *T. megaphylla* (Mett.) K. Iwats. S-1640, S-1777, *T. salicifolia* (Wall. ex Hook.) Reed S-1637, S-1694, *T. sp.* S-1771, *Dryoathyrium boryanum* (Willd.) Ching S-1776, *Diplazium petiolare* Presl S-1679, *Pleopeltis longifolia* Blume S-1772, *Microsorium scolopendria* (Burm.) Copel. S-1696, *Aglaomorpha heraclea* (Kunze) Copel. S-1782, *Loxogramme* sp. S-1769, *Crypsinus platyphyllus* (Sw.) Copel. S-1775, *Ctenopteris alata* (Blume) Holtt. S-1690 and *C. obliquata* (Blume) Copel. S-1768.

At Takegeun we visited the Local Forestry Office first, but unfortunately the forest officer was ill and he sent his assistant with us for two days while we worked in the Takegeun area. We also had to report to local police headquarters for registration before we left there. A small Losmen (cheap hotel) in which we spent three nights was not very comfortable, though the scenery of Laut Tawar was very beautiful. We had only two days for field work there, and spent one day driving inland and the other day in exploring limestone areas.

On 2 September we went southwards into a mountainous area, along the way from Takegeun to Isak. This way further proceeds via Uwak to Blangkejeren, though the path is at present only passable for pedestrians and pomes and a road for motor vehicles is now under construction. We made botanical observations on that day at an elevation between 1,300–2,200 m alt., and the vegetation there was at a glance quite similar to that at Cameron Highlands in Malaya. The slope is comparatively dry even in dense forest, and

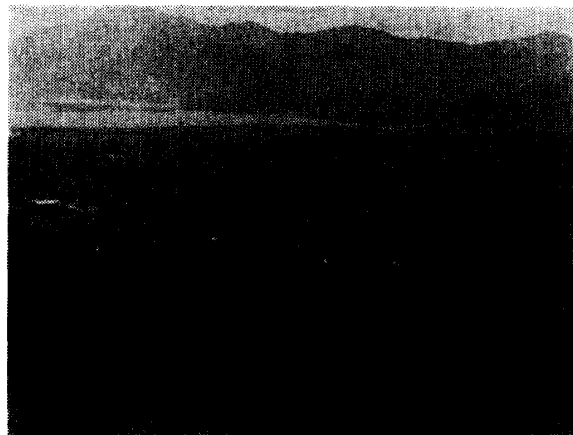


Photo. 8 Laut Tawar and Takegeun

wide areas are covered by pines, *Pinus merkusii*. Our collection was rich on that day including such pteridophytes as

Lycopodium cernuum L. S-1446, *L. clavatum* L. S-1440, *L. platyrhizoma* Wilce. S-1438, *L. serratum* Thunb. S-1369, *Selaginella intermedia* (Blume) Spring S-1362, S-1381, *Osmunda javanica* Blume S-1380, *Gleichenia longissima* Blume S-1432, *G. truncata* var. *plumiformis* (Presl) Holtt. S-1520, *Dicranopteris curranii* Copel. S-1433, *D. pubigera* (Blume) Nakai S-1519, *Dennstaedtia scabra* (Wall. ex Hook.) Moore S-1377, *Microlepia puberula* v. A. v. Ros. s. lat. S-1360, *Hypolepis punctata* (Thunb.) Mett. ex Kuhn S-1436, *Pteridium aquilinum* var. *wightianum* (Ag.) Tryon S-1521, *Lindsaea odorata* Roxb. S-1372, *Sphenomeris chinensis* (L.) Maxon S-1441, *Davallia trichomanoides* Blume S-1427, *Humata repens* (L. f.) Diels S-1367, *Antrophyum semicostatum* Blume S-1379, *Vittaria elongata* Sw. S-1357, S-1426, *Asplenium caudatum* Forst. S-1365, *Blechnum orientale* L. S-1435, *Woodwardia auriculata* Blume S-1359, *Dryopteris hirtipes* (Blume) O. Ktze. s. lat. S-1373, *Arachniodes* sp. S-1361, *Polystichum prolificans* v. A. v. Ros. S-1371, *P.* sp. S-1368, *Thelypteris beddomei* (Baker) Ching S-1431, *T. torresiana* (Gaud.) Alston S-1428, *T. setigera* (Blume) Ching S-1355, *T. unita* (L.) Morton S-1444, *T. callosa* (Blume) K. Iwats. S-1429, *T. dentata* (Forsk.) St. John S-1442 bis, T-1445, *T. parasitica* (L.) Tard. S-1439, S-1442, *T. malayensis* (C. Chr.) Reed S-1434, *T. toppingii* (Copel.) K. Iwats. S-1434 bis, *T. megaphylla* (Mett.) K. Iwats. S-1443, *Dryoathyrium boryanum* (Willd.) Ching S-1363, *Athyrium drepanopterum* (Kunze) A. Br. S-1430, S-1448, *Diplazium pallidum* (Blume) Moore S-1356, S-1447, *Diplazium polypodioides* Blume s. lat. S-1364, *D. accedens* Blume S-1374, *Dipteris conjugata* Reinw. S-1437, *Pyrrosia winkleri* (Rosenst.) Tagawa S-1375, *Belvisia revoluta* (Blume) Copel. S-1376, *Microsorium nigrescens* (Blume) Copel. S-1358, *Photinopteris acuminata* (Willd.) Morton S-1506, *Crypsinus platyphyllus* (Sw.) Copel. S-1366, *C. trilobus* (Houtt.) Copel. S-1505, *C. hagerupii* (C. Chr.) Tagawa S-1378 and *Polypodium persicifolium* Desv. S-1370.

In the morning of our second day in Takingeun area, 3 September, we went to Kampung Burni Bies, northwest of Takingeun, to botanize the limestone area in this village at about 1,200 m from sea level. We went there at the suggestion of the local forest officer who in reply to our inquiry told us that there were areas of limestone near this village. We asked the people there and they took us to two small caves on an uplifted coral reef along the river. Around the entrance of these caves small bushes are formed with several species of the pteridophytes such as

Selaginella frondosa Warb. S-1575, *Davallia corniculata* Moore S-1577, *Antrophyum callifolium* Blume S-1552, *Vittaria elongata* Sw. S-1547, *Pteris ensiformis* Burm. S-1574, *P. biaurita* L. S-1576, *Asplenium decorum* Kunze S-1539, *A. macrophyllum* Sw. S-1557, *A. salignum* Blume S-1543, S-1544, S-1549, *A. unilaterale* Lam. S-1548, *A. robustum* Blume S-1545, *Tectaria melanocaulon* (Blume) Copel. S-1546, *Heterogonium pinnatum*

(Copel.) Holtt. S-1551, *Diplazium accedens* Blume S-1542 and *Loxogramme scolopendrina* (Bory) Presl S-1550.

There are several limestone cliffs in Kampung Burni Bies, but all of them are dry and exposed. In fact, we saw no dense forest there, and we could not expect to collect on any limestone plants in this village. They suggested we should try on Gunung Beringtang (1,520 m), the limestone peak in this area, though we had not enough time to make any exploration on that mountain.

In the afternoon of that day we came back to Takingeun and worked along the path on the southern shores of Laut Tawar. The surface of this lake is about 1,100 m above sea level, and the places we visited were just a little above there. There are several limestone cliffs exposed in clearings or in light shade in thin pine forest. The flora in this limestone area is also poor, for the air and soil are rather dry even along this large lake. On the opposite (i.e. northern) shore of the lake we could see many limestone cliffs in pine forest, although there was no jeepable road and we did not have time to botanize there by hiring a boat. The pteridophytes collected in this afternoon are

Selaginella alutacea Sping S-1596?, *Adiantum malesianum* Ghatak S-1586, *Pteris vittata* L. S-1587, *Hypodematium crenatum* (Forsk.) Kuhn S-1583, *Pyrrosia abbreviata* (Zoll.) Tagawa S-1591, S-1599, *P. floccigera* (Blume) Ching S-1598 and *Belvisia revoluta* (Blume) Copel. S-1597.

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