

VEGETATION OF KHAO YAI NATIONAL PARK

by

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Introduction: Khao Yai National Park is not very far from Phra Nakhon (Bangkok) and can be easily reached by motor car within 4 hours covering a distance of about 200 Km. Studies in the natural history of the Park have been currently taken e.g. butterflies (REEVES 1966 & 1967); birds (DICKINSON 1963 & 1967); and orchids (CUMBERLEGE & CUMBERLEGE 1964), therefore an account of the vegetation is much needed.

The study of the vegetation of the Park started in January 1925, when the late Dr. A.F.G. KERR made a short visit to Khao Laem (1238 m) via Ban Tachang. Since the promulgation of the National Park in 1965, extensive studies were currently carried out by the Royal Forest Department in co-operation of foreign botanists. In November 1962, Dr. R.G. ROBBINS accompanied by the author made a preliminary study on the Lower Montane or Hill Evergreen forest of Khao Khieo (1400 m). A brief description of the vegetation of the Park is also given by CUMBERLEGE & CUMBERLEGE (loc. cit.).

During the Second Forestry Conference, Phra Nakhon, 9th-17th September, 1968 a paper on the Vegetation of Khao Yai National Park (in Thai), was read by the author, it is therefore appropriate to render this paper into English to supplement another studies already taken and yet to be carried on in the future.

Geography: Khao Yai National Park is between $14^{\circ}5' - 14^{\circ}15'$ North Latitude and $101^{\circ}5' - 101^{\circ}50'$ East Longitude, covering 2085 sq.km, having a rough rectangular in outline and having its boundary as follows:— the North in Pak Chong, Nakhon Ratchasima, the East in Pak Chong, Nakhon Ratchasima and Kabin Buri in Prachin Buri along the Nakhon Ratchasima—Kabin Buri Highway, the South in Nakhon Nayok and the West in Kaeng Khoi, Saraburi.

The physiography of this National Park, except the low undulating land in the East, is mountainous varying from 250-1400 m from the sea level; this mountainous area is a part of the Phanom Dongrek

Range, which is the source of the Lam Takhrong flowing eastwards and northwards then northeastwards beyond the boundary down to Pak Chong. It is also the source of the Nakhon Nayok River flowing southwards beyond the boundary at Nang Rong and Sarika Falls.

The mountainous area is composed of 3 high ridges, Khao Laem in the North-East, Khao Khieo in the South-East and Khao Sam Yot in the West, with highest peaks of about 1400, 1300 and 1200 respectively.

The northern and eastern sides are gradually sloping down towards the Mitraphap (Friendship) Highway between Pak Chong and Nakhon Ratchasima and towards the Nakhon Ratchasima-Kabin Buri Highway in Kabin Buri. The South and West slopes steeply drop into the agricultural area.

Climate: These steep slopes create a milder climate along the ridges as they get the full impact of the South-West monsoon causing heavy rainfall during July-October; besides during the month of November the Northeast monsoon is also prevailing.

The average rainfall is about 4000 mm, and it is expected to be heavier along the high ridges. The highest temperature is about 30°C during April-May and the lowest one is about 6°C during December-January.

Geology: As the National Park is covering an extensive area, the geological aspect is much varied. Along the Phanom Dong Rek Range, the bed rocks are composed with Permian and Jurassic limestones of the Ratchaburi and Kamawkala series respectively, to be seen exposing along both sides of the Dhanarat Road, the upper rock material are composed of Jurassic sandstone of the Korat series with shale, schist and gneiss; conglomerate is found along the Lamtakhleng. Along the southern steep slopes the bed rocks are granitic and conglomerate, with the upper strata of Jurassic sandstone. The eastern portion in Kabin Buri has the Jurassic limestone of the Kamawkala series as bed rock topped with the Jurassic sandstone.

Vegetation:— The vegetation of the National Park can be classified into 5 categories:—

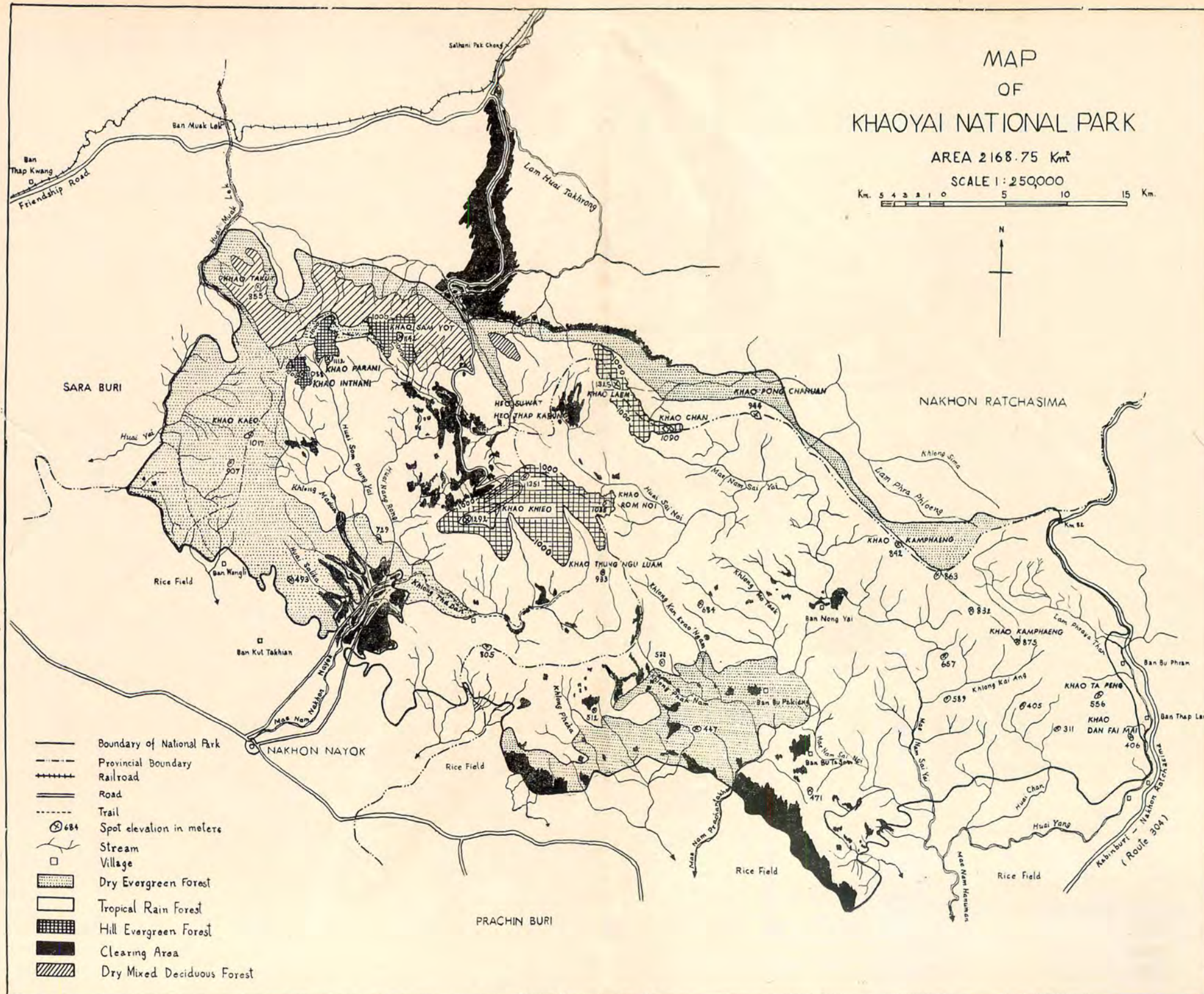
AREA 2168.75 Km²

SCALE 1:250,000

Km. 5 4 3 2 1 0 5 10 15 Km.

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Tropical Rain forest along stream at 700 m alt. Palms are *Daemonorops* sp.; trees are *Altingia siamensis* and *Lithocarpus* sp. (W.R. SCHEIBLE photo).



Tropical Rain forest along stream, 700 m alt. showing dense formation of undergrowth. (W.R. SCHEIBLE photo).

1. *Dry Mixed Deciduous forest.* The vegetation of this type is occurring along the northern slope between 400-600 m elevation. Tree species in this type of forest are *Afzelia xylocarpa*, *Pterocarpus macrocarpus*, *Lagerstroemia calyculata*, *Pterocymbium javanicum*, *Gmelina arborea*, *Adina cordifolia*, *Vitex pinnata*, *Xylia kerrii*, *Terminalia bellirica*, *Garuga pinnata*, and *Anogeissus acuminata*; the ground flora is composed of *Bambusa arundinacea* and varieties of grasses. Within this forest limestone outcrops are not uncommon.

2. *Dry Evergreen forest.* This forest type occurs along the eastern border in Nakhon Ratchasima and Prachin Buri on the peneplain of 100-200 m elevation. The upper stories are composed of *Dipterocarpus alatus*, *Vatica cinerea*, *Shorea sericeiflora*, *Hopea odorata*, *H. ferrea*, *Lagerstroemia calyculata*, *Tetrameles nudiflora*, *Lophopetalum wallichii*, *Afzelia xylocarpa*, *Pterocymbium javanicum*, *Parkia streptocarpa*, *Erythrophloeum succirubrum* and *Carallia brachiata*, together with under-storied species such as *Hydnocarpus ilicifolius*, *Aglaia* spp., *Loniciera microstigma*, *Memecylon floribundum*, etc. Besides *Areca triandra*, *Corypha lecomtei* is the more frequent species of palms. The ground flora is composed of members of *Marantaceae* (*Phrynium* and *Cucurligo*), and *Zingiberaceae* (*Achasma*, *Curcuma*, *Amomum*, *Catymbium* and *Ctenelophon*), together with *Musa acuminata* and *Pandanus* sp.

The forest shown in the profile diagram (Fig. 1) is not by far typical for a Dry Evergreen type. It has been through exploitations in past decades. Timber trees of more economic value, i.e. *Dipterocarpus* spp. and *Anisoptera costata* have been removed leaving large gaps in the crown canopy. The profile is showing a 3-storied facies with *Pterocymbium javanicum* and *Hopea ferrea* forming the top storey; the second storey is composing of *Nephelium longanum*, *Linociera microstigma*, *Horsfieldia irya*, and *Diospyros* sp., whereas the lowest storey is formed up by *Hydnocarpus ilicifolius*, *Murraya paniculata* and *Vitex quinata*.

In this case *Dipterocarpus* and *Anisoptera* seem to loose their chance of establishing, and give way to the better-regenerated *Hopea ferrea*. This will explain the almost pure stand of *H. ferrea*, often

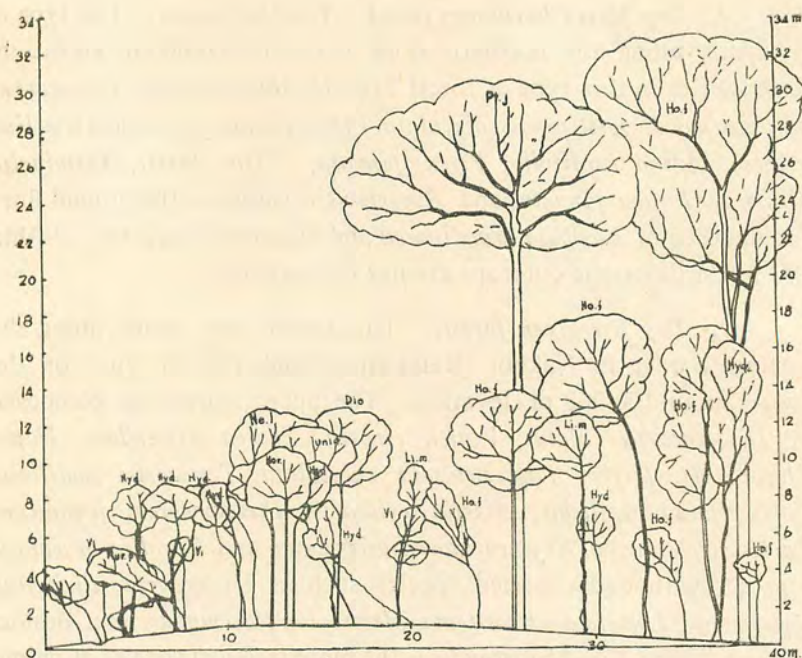


Fig. 1.

Profile diagram showing a Dry Evergreen forest at 380m alt. Ho. f.=*Hopea ferrea*; Pt. j.=*Pterocymbium javanicum*; Hyd.=*Hydnocarpus ilicifolius*; Li. m.=*Linociera microstigma*; Vi.=*Vitex quinata*; Dio.=*Diospyros* sp.; Ne. l.=*Nephelium longanum*; Mur. p.=*Murrara paniculata*; Unid.=Unidentified. (Drawn by Anan Nalampoon, 1965).

come across in this forest type, where the soil is generally shallow, being either lateritic or gravelly with broken shale. *Hopea ferrea*–*Hydnocarpus ilicifolius*–*Vitex quinata* associates seem to denote this natural phenomena. Consequently the height of the top storey is reduced (33-35 m) from the normal (40-45 m).

3. *Tropical Rain forest.* The forest of this type, being the majority, covers vast area of the Park from 400 to 1000 m elevation. In the lower elevation the vegetation is similar to the Dry Evergreen forest, only more members of the *Dipterocarpaceae* are being present namely, *Dipterocarpus dyeri*, *D. baudi*, *D. gracilis* and *Anisoptera costata*; *Duabanga grandiflora* and *Anthocephalus cadamba* are frequent along the valleys. Deciduous species such as *Pterocymbium javanicum*,



Forest on the slope of about 1200 m alt., oaks and podocarps formation. (Llewelyn WILLIAMS photo).



Forest near summit, 1300 m alt., oaks, podocarps and Dacrydium formation. Trees at left are *Dacrydium elatum*. (L. WILLIAMS photo).



Forest along slope on ridge near summit, 1300 m alt. Big tree at left of the man is *Schima wallichii*; straight-stemmed tree facing the same man is *Podocarpus fleuryi*; white-stemmed tree at far right is *Castanopsis acuminatissima* with *Schima wallichii* at its left. (L. WILLIAMS photo).



Forest on ridge, 1300 m alt. *Schima*-*Castanopsis* formation. (L. WILLIAMS photo).

Tetrameles nudiflora and *Adina cordifolia* are either very scattered or almost absent. The ground flora is similar to that of the Dry Evergreen forest, only much denser in nature. A large-clumped, long-culmed bamboo *Dendrocalamus longispathus* is forming thickets along streams.

The climbing screw-pine (*Freycinetia* sp.), a climbing fern (*Stenochloena palustris*) and a creeping aroid (*Anadendron* sp.) are characteristic to this type of forests, whereas *Livistona cochinchinensis*, *Calamus* sp. and *Licuala* sp. are among the frequent species of palms.

In the higher elevation *Dipterocarpus baudi*, *D. dyeri*, and *Anisoptera costata* are being absent, and replaced by *Dipterocarpus costatus* and *D. macrocarpus*; other tree species associating in the upper stories besides *Shorea sericeiflora*, are *Altingia siamensis*, *Poupartia axillaris*, *Aromadendron spongocarpum*, *Calophyllum polyanthum*, and *Schima wallichii*. A number of oaks and chestnuts, e.g. *Lithocarpus annamensis*, *L. eucalyptifolius*, *L. rodergianus*, *Quercus fleuryi*, *Q. myrsinaefolia* and *Castanopsis acuminatissima* are forming the under-storied stand together with *Palaquium koratense*, *Linociera thorelii* and *Ligustrum confusum*. The shrubby species are as follows: *Embelia ribes*, *Maesa ramentacea*, *Viburnum punctuatum*, *Sambucus javanicus*, *Loniciera bournei*, *Uncaria homomalla*, *Mussaenda sanderiana*, *Canthium brunnescens*, *Prismatomeris tetrandra*, *Psychotria adenophylla*, *Entada phaseoloides*, *Rubus cochinchinensis*, *Itea riparia*, *Aralia armata*, and *Tupidianthus calyptratus*.

A gracefully close-clumped, small-culmed bamboo belonging to the genus *Schizostachyum* is found scatteringly along the valleys.

Along the stream banks tree ferns, i.e. *Cyathea borneensis*, *C. latebrosa* and *C. podophylla* are frequent together with *Cibotium barometz*, *Gleichenia norrisii*, and *Dicranopteris curranii*, the latter two having a gracefully straggling habit. On rocks in rapids moss-like members of the family *Podostemonaceae* are found, i.e.:— *Cladopus nymanii*, and *Polypheurella micrantha* for instant.

Among epiphytes, *Drynaria rigidula*, *Phytinopteris speciosa*, *Platyserium wallichii* and *Pseudodrynaria coronans* are the most common ferns, whereas *Aerides falcatum*, *Agrostophyllum longifolium*, *Bulbophyl-*

lum macranthum, *B. blepharistes*, *Cymbidium simulans* and *Pholidota pallida* are the most common orchids. Filmy ferns belonging to the genera *Hymenophyllum* and *Trichomanes* are growing among mosses on tree trunks. Epiphyllous hepatics are also frequent on leaves along the streams and valleys, among these the genus *Calolejeunea* is more evident.

The profile diagram (Fig. 2) does not represent a typical Tropical Rain forest type. The site has previously been exploited, and economic species (*Dipterocarpus*, *Shorea*, *Hopea*) have been removed leaving open gaps in the crown canopy. The forest still has the 3-storied facies with *Pterocymbium javanicum* in the top story; *Dipterocarpus* spp. as second story; *Knema conferta*, *Syzygium* sp. and *Erythrina* sp. forming the lowest story.

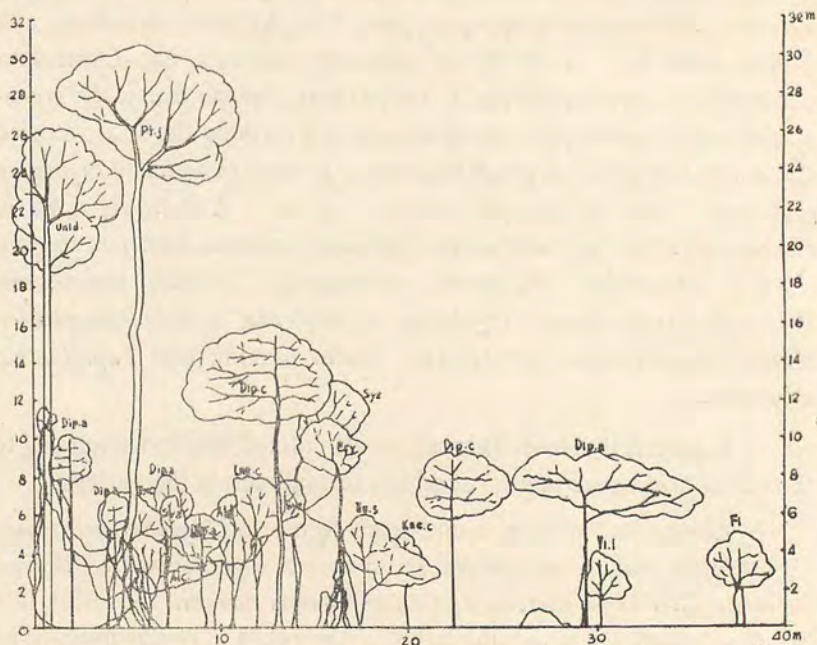


Fig. 2.

Profile diagram showing a Tropical Rain forest, at alt. 700m Pt.j.=*Pterocymbium javanicum*; Dip. c.=*Dipterocarpus costatus*; Dip. a.=*Dipterocarpus alatus*; H.f.=*Hopea ferrea*; Syz.=*Syzygium* sp.; Exc.=*Excoecaria* sp.; Alc.=*Alchornea* sp.; Kne. c.=*Knema conferta*; Eu. s.=*Eugenia siamensis*; Ery.=*Erythrina* sp. Vi. l.=*Vitex limonifolia*; Fi.=*Ficus* sp.; Unid.=Unidentified. (Drawn by Anan Nalampoon, 1965).

In the long run *Dipterocarpus* spp. will grow up beyond *Pterocymbium javanicum*, becoming the top-storied species and leaving the latter and other species (unidentified) in the second story. Comparing to the Dry Evergreen forest (Fig. 1), at a higher elevation (700 m) *Dipterocarpus* spp. seem to have a better chance to establish. This probably due to the nature of soil and the amount of precipitation.

4. *Hill Evergreen forest.* From the altitude of 1000 m upwards the change in the forest is markedly denoted. Members of the *Dipterocarpaceae* stop at this elevation and are replaced by those of gymnosperms, namely *Podocarpus neriifolius*, *P. imbricatus* and *P. fleuryi* with *Dacrydium elatum* and the same species of oaks and chestnuts occurring in the Tropical Rain forest of the higher elevation, except *Lithocarpus annamensis*, and *Quercus myrsinaefolius* which seem to confine to the 600-900 m altitude. *Betula alnoides* is scattered along ridges.

The forest is rather dense, and, besides the upper-storied tree species mentioned above, the following under-storied species: *Olea maritima*, *Litsea multumbellata*, *Vaccinium sprengelii*, *Rhus succedanea*, *Adina polycephaloides* and *Syzygium* sp. are being observed. The ground flora is composed of shrubby species, e.g. *Melastoma malabathricum*, *Evodia gracilis*, *Combretum quadratum*, *Brassaiopsis speciosa*, *Macropanax oreophilum*, *Rhamnus cambodianus*, *Psychotria symplocifolia*, *Saprosma latifolium*, *Senecio walkeri*, *Lonicera bournei*, *Embelia kerrii*, and *Ardisia eglandulosa*, together with a number of terrestrial ferns and orchids. Along the flat-topped ridge, a small, wet, open spot with sand-stoned hard pan occurs, and is well covered with *Sphagnum* and other mosses together with herbaceous species, such as, *Burmannia disticha*, *Osbeckia chinensis*, *Xyris* sp., *Oldenlandia* sp., *Fimbristylis trichoides*, *Murdania* spp., and *Lycopodium cernuum*.

Epiphytic species are abundantly covering trunks and branches of trees. They are composed of *Agapetes bracteata*, a podagraceous species, and a number of orchids, (*Ione*, *Bulbophyllum*, *Thelasis*, *Eria*; *Dendrobium*, *Porpax*, *Otochilus*, *Oberonia* and *Pholidota*) ferns (*Hymenophyllum*, *Trichomanes*, *Davallia*, *Polypodium*, *Vittaria* and *Pyrrosia*) mosses and hepatics.

The profile diagram (Fig. 3) shows the vegetal formation of a Hill Evergreen or Lower Montane forest type on ridges. The upper layer is being formed up by *Anneslea fragrans*, *Podocarpus imbricatus*, *Rhus succedanea*, *Premna* sp., and *Eugenia* sp., while the second layer is represented by *Olea maritima* and *Canthium* sp. with a number of shrubby species (*Vaccinium sprengelii* and *Litsea multiumbellata*).

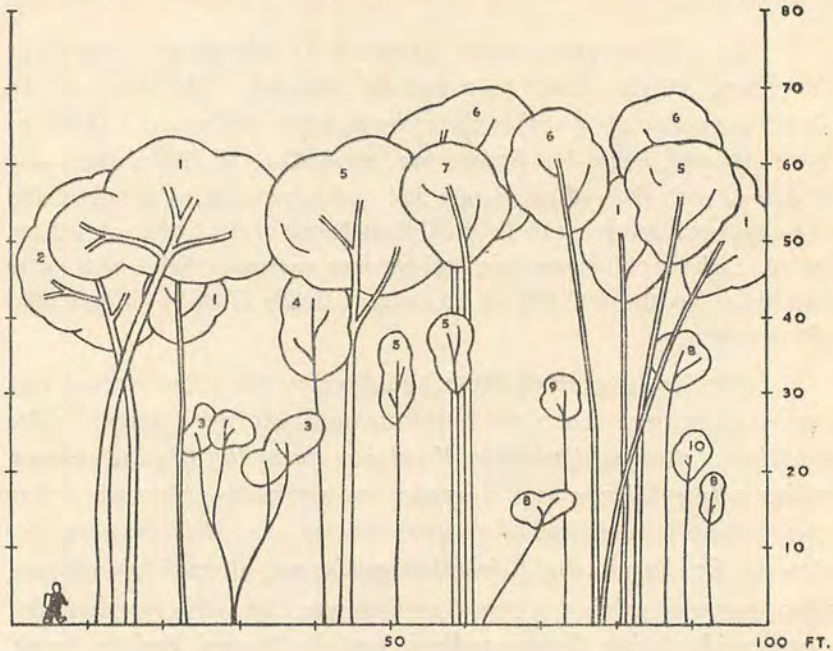


Fig. 3.

Profile diagram showing the Hill Evergreen or Lower Montane forest on Khao Khieo ridge ca 1300m alt. 1. *Anneslea fragrans*; 2. *Premna* sp.; 3. *Vaccinium sprengelii*; 4. *Canthium* sp.; 5. *Eugenia* sp.; 6. *Podocarpus imbricatus*; 7. *Rhus succedanea*; 8. *Olea maritima*; 9. Lauraceae; 10. *Litsea multiumbellata*. (Drawn by R.G. ROBBINS xi. 62.).

If *Olea maritima* is to be classified as a shrubby tree, and *Canthium* sp. as a member of the top layer, evidently shown by its emerging crown; the profile itself will represent the low gymnosperm mixed forest on dry poor ranges approaching a single layer montane type.

5. *Grassland and Secondary Growth.* The grassland and secondary growth are the recent effect of Man. The former is due to the shifting cultivation in the past 40 years, while the latter is the effect

of the road construction and the effective fire control of the grassland after the enactment of the National Park.

In the grassland the main species is *Imperata cylindrica* with a number of tall grasses, i.e. *Neyraudia reynaudiana*, *Themeda arundinacea*, *Saccharum spontaneum* and *Thysanolaena maxima*, sparsingly grow together. Among grasses the following ferns, *Pteridium aquilinum*, *Dicranopteris linearis*, *Ophioglossum* spp., *Cheilanthes tenuifolia*, *Selaginella* spp., and *Helminthostachys zeylanica* are frequent. Owing to the effective fire control seedlings and sapplings of pioneer species are settling in such as, *Macaranga* sp., *Mallotus cochinchinensis*, *Poupartia axillaris*, *Duabanga grandiflora*, *Anthocephalus cadamba*, *Melia azedarach*, and *Glochidion* sp.

It is to be expected that in the future the well-protected grassland will eventually become a forest of the secondary type.

The secondary growth in the lower elevation (400-1000 m) is found on both sides of roads, and composing of pioneer species mentioned above with the addition of *Hibiscus macrophyllus*. In the higher elevation (1000-1300 m) the speciation is markedly different, only few pioneer species found, namely *Betula alnoides* and *Mallotus* sp. A bamboo belonging to the genus *Schizostachyum* is quickly forming a luxuriant growth along the edges of the forest together with the fern *Histiopteris excisa*. Seedlings of *Podocarpus imbricatus* and *Dacrydium elatum* are sparsely found within the new clearings.

It is very interesting to see *Betula alnoides* establishing on barren, steep side-cuts of the road; some sapplings are 4-5 m high. As the road in the higher elevation was begun sometimes in 1962, the rate of growth of this pioneer species is therefore rather high.

Conclusion : As having previously stated that plant collection of the Park is far from completion, and thus the knowledge of its flora is still not adequate to draw any conclusion on the plant distribution. The distribution of certain species of the higher elevation shown in Table 1 will give some idea for further study.

TABLE 1
Distribution of species of higher elevation

| Species | Thailand | Indo-Burmese (Himalayan) | Indo-Chinese (Annamatic) | Malesian | Remarks |
|--|----------|-----------------------------|-----------------------------|----------|--|
| <i>Ternstroemiaceae</i> | | | | | |
| <i>Camellia confusa</i> | X | X | — | — | |
| <i>Eurya japonica</i> var. <i>nitida</i> | X | X | X | — | |
| <i>Sladenia celastriifolia</i> | X | X | X | — | |
| <i>Ternstroemia japonica</i> | X | X | X | — | |
| <i>Dipterocarpaceae</i> | | | | | |
| <i>Dipterocarpus gracilis</i> | X | X | — | X | |
| <i>D. costatus</i> | X | X | X | X | |
| <i>D. macrocarpus</i> | X | X | — | — | |
| <i>Shorea sericeiflora</i> | X | X | — | X | |
| <i>Malvaceae</i> | | | | | |
| <i>Hibiscus macrophyllus</i> | X | X | X | X | |
| <i>Sterculiaceae</i> | | | | | |
| <i>Reevesia siamensis</i> | X | — | — | — | Also found in Loei |
| <i>Hammamelidaceae</i> | | | | | |
| <i>Altingia siamensis</i> | X | — | — | — | Also found in Chaiphaphum, Phitsanulok and Chiang Rai |
| <i>Rosaceae</i> | | | | | |
| <i>Rubus cochinchinensis</i> | X | X | X | — | |
| <i>Pyrus crenulata</i> | X | — | — | — | Also found in Trat |
| <i>Rhamnaceae</i> | | | | | |
| <i>Rhamnus cambodiana</i> | X | — | X | — | |
| <i>Combretaceae</i> | | | | | |
| <i>Combretum quadratum</i> | X | — | — | — | Endemic to the Park |
| <i>Myrtaceae</i> | | | | | |
| <i>Rhodamnia siamensis</i> | X | — | X | — | |

| Species | Thailand | Indo-Burmese (Himalayan) | Indo-Chinese (Annamatic) | Malesian | Remarks |
|---|----------|-----------------------------|-----------------------------|----------|-------------------------------|
| <i>Melastomaceae</i> | | | | | |
| <i>Osbeckia chinensis</i> | X | X | X | X | |
| <i>Medinilla caerulea</i> | X | — | X | — | |
| <i>Passifloraceae</i> | | | | | |
| <i>Passiflora leschenaultii</i> | X | X | — | — | |
| <i>Umbelliferae</i> | | | | | |
| <i>Oenanthe benghalensis</i> | X | X | X | — | |
| <i>Araliaceae</i> | | | | | |
| <i>Brassaiopsis speciosa</i> | X | X | — | X | |
| <i>Macropanax oreophilum</i> | X | X | X | X | |
| <i>Caprifoliaceae</i> | | | | | |
| <i>Viburnum punctatum</i> | X | X | X | — | |
| <i>Sambucus javanica</i> | X | X | X | X | |
| <i>Lonicera bournei</i> var. <i>obscura</i> | X | X | — | — | |
| <i>Rubiaceae</i> | | | | | |
| <i>Adina polycephaloides</i> | X | X | — | — | |
| <i>Hedyotis cystoides</i> | X | — | — | — | |
| <i>Mussaenda sanderiana</i> | X | X | — | — | |
| <i>Psychotria serpens</i> | X | X | X | — | |
| <i>P. symplocifolia</i> | X | X | — | — | |
| <i>Saprosma latifolium</i> | X | — | — | — | Also found at Nakhon Sawan |
| <i>Compositae</i> | | | | | |
| <i>Vernonia craibiana</i> | X | — | — | — | Endemic to the Park |
| <i>Microglossa volubilis</i> | X | X | X | X | |
| <i>Blumea semivestita</i> | X | X | X | — | |
| <i>Senecis walkeri</i> | X | X | X | X | |
| <i>Vacciniaceae</i> | | | | | |
| <i>Agapetes bracteata</i> | X | X | X | — | |
| <i>Myrsinaceae</i> | | | | | |
| <i>Embelia kerrii</i> | X | — | — | — | Endemic to the Park |
| <i>E. pulchella</i> | X | X | X | — | |

| Species | Thailand | Indo-Burmese (Himalayan) | Indo-Chinese (Annamatic) | Malesian | Remarks |
|--|----------|-----------------------------|-----------------------------|----------|--|
| <i>Ardisia eglandulosa</i> | X | — | — | — | Also occurs in Nakhon Si Thammarat |
| Sapotaceae | | | | | |
| <i>Palaquium koratense</i> | X | — | — | — | Endemic to the Park |
| Oleaceae | | | | | |
| <i>Jasminum subtriplinerve</i> | X | X | X | — | |
| <i>Ligustrum confusum</i> | X | X | X | X | |
| Lentibulariaceae | | | | | |
| <i>Utricularia subulata</i> | X | — | — | X | |
| Acanthaceae | | | | | |
| <i>Acanthus leucostachys</i> | X | X | X | — | |
| <i>Rhaphidospora lanceolata</i> | X | — | — | — | Endemic to the Park |
| <i>Staurogyne rosulata</i> | X | — | — | — | Endemic to the Park |
| <i>Tetraglochin maingayi</i> var. <i>paucinervium</i> | X | — | — | — | „—“, |
| Fagaceae | | | | | |
| <i>Quercus fleuryi</i> | X | — | X | — | |
| <i>Q. myrsinaefolia</i> | X | — | X | — | |
| <i>Lithocarpus annamensis</i> | X | — | X | — | |
| <i>L. eucalyptifolius</i> | X | — | X | — | |
| <i>L. rodgerianus</i> | X | X | — | — | |
| Betulaceae | | | | | |
| <i>Betula alnoides</i> | X | X | X | — | |
| Araceae | | | | | |
| <i>Rhaphidophora hongkongensis</i> | X | — | X | — | |
| <i>Homalomena occulta</i> | X | X | X | — | |
| <i>Alocasia grata</i> | X | X | — | — | |
| Zingiberaceae | | | | | |
| <i>Caulokaempferia saxicola</i> | X | — | — | — | Endemic to the Park |

| Species | Thailand | Indo-Burmese (Himalayan) | Indo-Chinese (Annamatic) | Malasian | Remarks |
|------------------------------------|----------|-----------------------------|-----------------------------|----------|---------------------|
| Marantaceae | | | | | |
| <i>Stachyphrynium tetranthum</i> | X | — | — | — | Endemic to the Park |
| Thismiaceae | | | | | |
| <i>Thismia mirabilis</i> | X | — | — | — | Endemic to the Park |
| Liliaceae | | | | | |
| <i>Neolourya thailandica</i> | X | — | — | — | Endemic to the Park |
| <i>Peliosanthes camberledgei</i> | X | — | — | — | Endemic to the Park |
| Orchidaceae | | | | | |
| <i>Habenaria garrettii</i> | X | X | — | — | Endemic to the Park |
| <i>Tainia latifolia</i> | X | X | — | — | |
| <i>T. wrayana</i> | X | X | — | X | |
| <i>Nephelaphyllum latilabre</i> | X | — | — | X | |
| <i>Chrysoglossum ornatum</i> | X | — | — | X | |
| <i>C. robinsonii</i> | X | — | — | — | Endemic to the Park |
| <i>Pholidota recurva</i> | X | X | — | — | Endemic to the Park |
| <i>Oberonia caudata</i> | X | X | — | — | |
| <i>O. pendula</i> | X | — | — | X | |
| <i>Nervilia cumberlegei</i> | X | — | — | — | |
| <i>Dendrobium heterocarpum</i> | X | X | X | — | |
| <i>D. crystallinum</i> | X | X | — | — | Endemic to the Park |
| <i>D. scabrilingue</i> | X | X | — | — | |
| <i>D. bicameratum</i> | X | X | — | — | |
| <i>D. acinaciforme</i> | X | X | X | — | |
| <i>D. anceps</i> | X | — | — | X | |
| <i>Eria microphylla</i> | X | — | — | X | |
| <i>E. stricta</i> | X | X | — | — | |
| <i>Acanthephippium parviflorum</i> | X | — | — | X | |
| <i>Bulbophyllum abbrevilabium</i> | X | X | — | X | |
| <i>B. suavissimum</i> | X | X | — | — | |
| <i>Pteroceras suaveolens</i> | X | — | — | X | |
| <i>P. appendiculatum</i> | X | — | — | X | |
| <i>Sarcanthus birmanicus</i> | X | X | — | — | |
| <i>Malleola dentifera</i> | X | — | — | X | |

| Species | Thailand | Indo-Burmese (Himalayan) | Indo-Chinese (Annamatic) | Malesian | Remarks |
|----------------------------------|----------|-----------------------------|-----------------------------|----------|------------------------|
| Cyperaceae | | | | | |
| <i>Fimbristylis trichoides</i> | X | — | — | — | Endemic to the Park |
| <i>Carex indica</i> | X | X | X | X | |
| <i>C. baccans</i> | X | X | X | X | |
| <i>C. lageniformis</i> | X | — | X | — | |
| <i>Scleria terrestris</i> | X | X | X | X | |
| <i>Hypolytrum nemorum</i> | X | X | X | X | |
| <i>Lipocarpa chinensis</i> | X | X | X | X | |
| <i>Rhynchospora corymbosum</i> | X | X | X | X | |
| <i>Scirpus wichurae</i> | X | X | X | X | |
| Lycopodiaceae | | | | | |
| <i>Lycopodium hamiltonii</i> | X | X | X | — | |
| Selaginellaceae | | | | | |
| <i>Selaginella siamensis</i> | X | — | X | — | |
| Gleicheniaceae | | | | | |
| <i>Gleichenia norrisii</i> | X | — | — | X | |
| <i>Dicranopteris curranii</i> | X | — | — | X | |
| Hymenophyllaceae | | | | | |
| <i>Hymenophyllum exertum</i> | X | X | X | X | |
| <i>H. polyanthes</i> | X | X | X | X | |
| <i>Trichomanes bipunctatum</i> | X | X | X | X | |
| <i>T. obscurum</i> | X | — | X | X | |
| Polypodiaceae | | | | | |
| <i>Belvisia annamensis</i> | X | — | X | — | |
| <i>Pyrrosia eberhardtii</i> | X | — | X | — | |
| <i>Polypodium subauriculatum</i> | X | X | X | X | |
| <i>Photinopteris speciosa</i> | X | — | X | X | |
| Grammitidaceae | | | | | |
| <i>Ctenopteris khasyana</i> | X | X | X | — | |
| <i>Grammitis dorsipila</i> | X | — | X | — | |
| Dennstaedtiaceae | | | | | |
| <i>Microlepia herbacea</i> | X | — | X | — | |
| <i>Lindsaya lucida</i> | X | — | X | X | |
| <i>Diacalpe aspidioides</i> | X | X | X | X | |
| <i>Davallia divaricata</i> | X | — | X | X | |

| Species | Thailand | Indo-Burmese (Himalayan) | Indo-Chinese (Annamatic) | Malesian | Remarks |
|--------------------------------|----------|-----------------------------|-----------------------------|----------|---------|
| <i>Dryopteris integrifolia</i> | X | — | X | — | |
| <i>D. neoassamensis</i> | X | — | X | — | |
| <i>D. subtriangularis</i> | X | X | X | — | |
| <i>Hemigramma decurrens</i> | X | — | X | — | |
| <i>Histiopteris incisa</i> | X | X | X | X | |
| <i>Oleandra musifolia</i> | X | X | X | — | |
| <i>Polystichum biaristatum</i> | X | X | X | — | |
| <i>Adiantaceae</i> | | | | | |
| <i>Vittaria flexuosa</i> | X | X | X | X | |
| <i>Sphagnaceae</i> | | | | | |
| <i>Sphagnum cuspidatum</i> | X | X | X | X | |
| <i>Sph. cuspidatum</i> | X | — | X | X | |
| <i>Sph. erythrocalyx</i> | X | — | X | X | |

Of all 125 species listed in the table, 16 are endemic, 17 Himalayan, 14 Annamatic, and 12 Malayan elements. Among endemic species, 15 species are so far only known from the Park, but future investigations will prove that these may occur elsewhere, even outside Thailand. Twenty-two species seem to have their distribution range in West-East direction, where 5 species on Northwest-South, and 5 on the Northeast-South directions. The very wide-spread species are 24 in number with the majorities belonging to the *Compositae*, ferns, and *Sphagnum* mosses.

From this account the Park seems to be a meeting place, as well as a cross-road of species belonging to the three floristic elements.

Acknowledgement: The author wishes to tender his profound and respectful thanks to Mr. Dusit BHANIBHATANA, Director-General of Royal Forest Department for the sincere encouragement and full support to the study of the vegetation of the country on a large scale, and the kind permission to publish this paper for a wider circulation. Thanks are also due to Dr. R.G. ROBBINS, late of the School of Pacific Studies, Australian National University, Canberra for the valuable profile diagram of Khao Khieo Ridge with suggestive comments; to

Mr. Anan NALAMPOON, of Royal Forest Department, Bangkok, who painstakingly studied and drew up profile diagrams of various forest types in Thailand, of which two are being used; to Dr. Llewelyn WILLIAMS of USDA Crop Research Division, Beltsville, and Lieut. Col. W.R. SCHEIBLE, USAF, late of ARPA/MRDC Office, Bangkok in so kindly providing photographs for the illustration.

REFERENCES

- BOR, N.L. 1965. Graminae in K. LARSEN, Studies in the Flora of Thailand. 26. Dansk Bot. Ark. **23**: 141-168.
- BREMEKAMPF, C.E.B. 1965. Scrophulariaceae-Nelsoniaceae, Thunbergiaceae, Acanthaceae in K. LARSEN, l.c. 32. Ibidem, 195-224.
- , — 1966. Thunbergiaceae and Acanthaceae in K. LARSEN, l.c. 35. Ibid. 273-279.
- CRAIB, W.G. 1925-1962. Florae Siamensis Enumeratio. Vols. 1-3 (Parts 1-3), Siam Society, Bangkok.
- CUMBERLEDGE, P.F. and V.M.S. CUMBERLEDGE 1963. A preliminary list of the orchids of Khao Yai National Park. Nat. Hist. Bull. Siam Soc. **20**: 155-182.
- DICKINSON, E.C. 1963. A preliminary list of the birds of Khao Yai National Park. Nat. Hist. Bull. Siam Soc. **20**: 183-204.
- HANSEN, Bertel 1966. Rutaceae in K. LARSEN, l.c. 36. Ibid. 281-293.
- , — 1966. Sphagnaceae in K. LARSEN, l.c. 37. Ibid. 295-300.
- , — 1968. Dioscoriaceae in K. LARSEN, l.c. 42. Ibid. 459-463.
- HJELMQVIST, H. 1968. Fagaceae, Betulaceae and Corylaceae in K. LARSEN, l.c. 44. Ibid. 473-516.
- HOLTUM, R.E. 1965. Filicinae in K. LARSEN, l.c. 33. Ibid. 225-244.
- HU, Sbiu-Ying 1968. Araceae in K. LARSEN, l.c. 41. Ibid. 409-457.
- JACOBS, M. 1962. Reliquiae Kerrianae. Blumea **11**: 427-493.
- KERN, J.H. 1961. Cyperaceae of Thailand. Reinwardtia **6**: 25-83.
- , — 1962. Cyperaceae of Thailand. II. Ibidem, 145-154.
- , — 1965. Florae Malesianae Procursores. XL. Notes on Malasian and some extra-Malasian Cyperaceae. Blumea **13**: 117-125.

- LARSEN, Kai 1963. Two new Liliaceae from the Khao Yai National Park. Bot. Not. **119**: 196-200.
- , — 1964. Studies on Zingiberaceae. IV.—Caulokaempferia, a new genus. Bot. Tidsskr. **60**: 165-179.
- , — 1965. Thismiaceae in K. LARSEN, l.c. 27. Ibid. 169-174.
- , — 1965. Marantaceae in K. LARSEN, l.c. 28. Ibid. 175-182.
- RAYMOND, Marcel 1965. The genus Carex in K. LARSEN, l.c. 34. Ibid. 245-262.
- , — 1966. Cyperaceae in K. LARSEN, l.c. 39. Ibid. 311-374.
- REEVES, Philip A. 1966. Notes on the butterflies of Khao Yai National Park. Part 1. Nat. Hist. Bull. Siam Soc. **21**: 1-20.
- ROYEN, P. van 1965. Podostemonaceae in K. LARSEN, l.c. 38. Ibid. 183-186.
- SEIDENFADEN, Gunnar and Tem SMITINAND 1959-1965. Orchids of Thailand. Siam Society, Bangkok.
- SLEUMER, H. 1966. Vacciniaceae in K. LARSEN, l.c. 38. Ibid. 301-305.
- TAGAWA, Motozi and Kunio IWATSUKI 1967. Enumeration of Thai Pteridophytes collected during 1965-66. S.-e. As. Stud. **5**: 23-120.
- TAYLOR, Peter 1968. Lentibulariaceae in K. LARSEN, l.c. 47. Ibid. 527-532.
- TIXIER, P. Bryophytae Siamensis, *in press*.