REPORT ON THE THIRD THAI–DANISH BOTANICAL EXPEDITION,

June — July, 1963.

By

KAI LARSEN

Botanical Institute, University of Århus, Denmark.

Tempted by the large number of incompletely known *Zingiberaceae* of Southeast Asia and by the many new species which it seems necessary to describe, the author planned an expedition to the evergreen forests of Thailand during the rainy reason in order to collect more adequate material of this plant group, generally represented in the herbaria by very poor material due to the difficulties in drying the specimens. The ordinary collecting methods, by drying, nearly always destroys the delicate flowers, they collapse totally in such a way that it is impossible to boil up the material in alcohol / water or other fluids. Collection of these plants ought to include a sample of the inflorescence or, in any case, single flowers, in alcohol or formalin. As modern cytotaxonomic research also is lacking in this group, it was also planned to undertake fixations in nature, as well as to bring home living material.

These plans could be realised through a grant from the Carlsberg Foundation and the kindness of the East Asiatic Company, whose management decided to offer free transport of the botanical collections and the expedition outfit. The author owes a great debt of gratitude to the Board of Directors.

This, however, would not have been enough to assure any success of a botanical expedition in Thailand. Without active help from the Royal Forest Department of Thailand an expedition would have met with insurmountable difficulties. Here the Director-General this time as before met our wishes with the greatest understanding and helpfulness. The Chief of the Botanical Section of the Royal Forest Department, Mr. ***Tem Smitinand***, as usual devoted a great part of his time to planning the travels. Both officials are offered my most cordial thanks.

To the Danish Ambassador to Thailand, Mr. ***Ebbe Munck***, who has taken particular interest in the expedition and helped in a number of ways I also owe a great debt of gratitude.

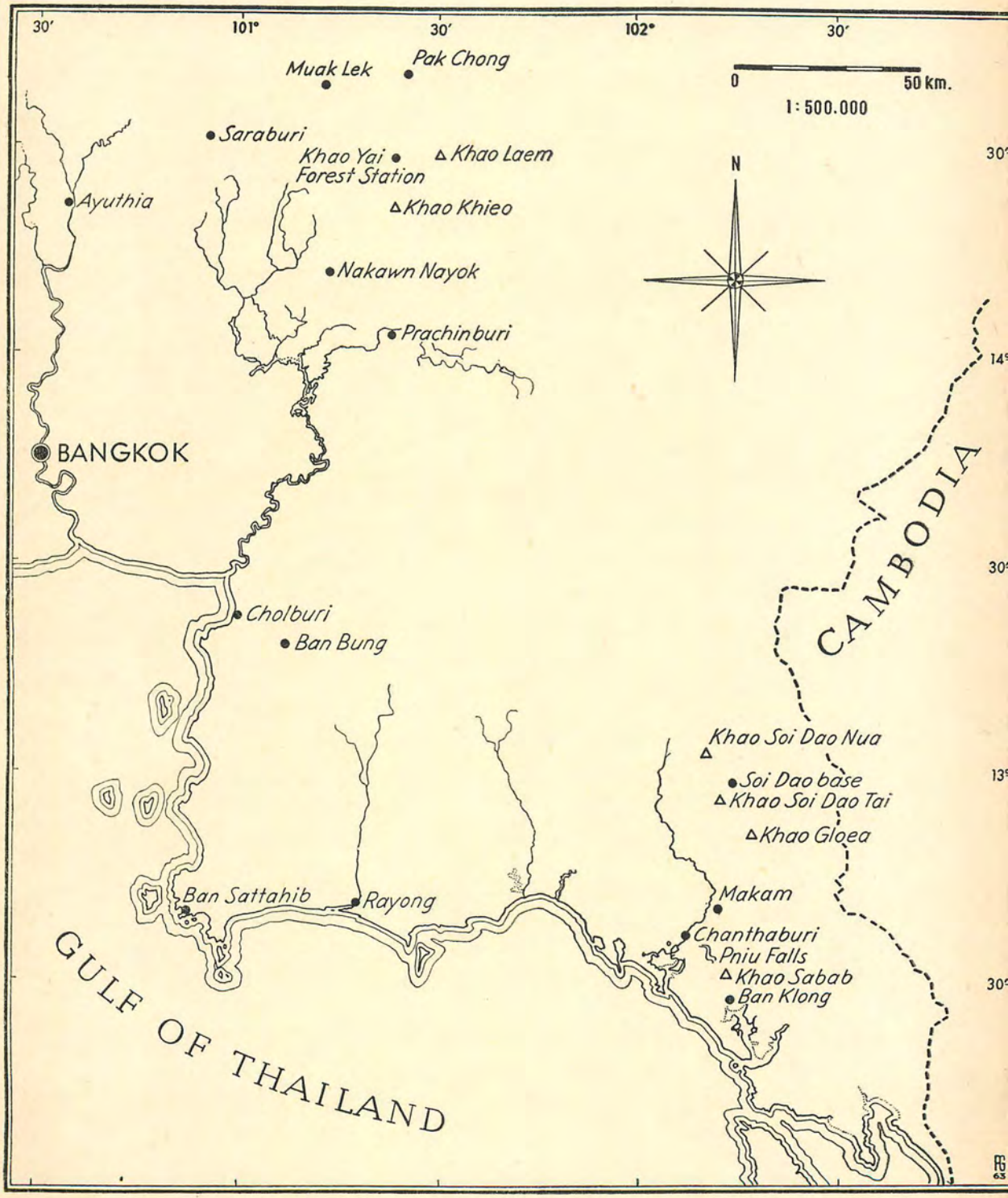
The offiicer in charge of the Khao Yai National Park, Mr. ***Pairochana Suvanakorn*** is thanked for help during my first stay at Khao Yai.

Finally some private persons quite unexpectedly came to play a role for the expedition. Mr. ***C.H. Yup***, Pagoda Farm, Thung Kang Yang, and Mrs. ***Rose Yup*** are both thanked most cordially for their hospitality and their keen interest in the botanical work. Through their help it was made possible for us to get an impression of the vegetation of the unnamed hills (here designed as the "Thung Kang Yang Hills") east of the farm, and to collect a very interesting material of *Zingiberaceae*. Another helping hand came from Mr. ***P.F. Cumberlege*** and Mrs. ***Cumberlege***, both eager orchid collectors and able field naturalists. The second stay in the Khao Yai Mountains was made possible by their kind invitation to visit their bungalow there. Also Mr. ***Khid Suvarnasuddhi*** is thanked for hospitality at his farm at the foothills of the Soi Dao Mountains.

The main purpose of the expedition, as has been pointed out, was the collection of *Zingiberaceae*, but of course also other plant groups were collected on the scale possible. Particular emphasis was laid on *Gramineae* and the *Liliflorae*, of which groups important cytological material have been brought home as a continuation of previous work (***Larsen*** 1963). Furthermore a certain number of Fungi and Mosses have been brought home to specialists in Denmark.

After proper treatment the whole material will be deposited in Copenhagen in the Botanical Museum (Herb. C). A duplicate set will be found in the herbarium of the Royal Forest Department, Bangkhen (Herb. BKF).

In order to facilitate the work for future monographers who may deal with material from this expedition a map of the southeastern part of Thailand has been included, showing the localities from where plants have been collected. As far as the Kanchanaburi province in the Rachaburi district is concerned (see ***Larsen*** ed. 1961), all the place-names will be found on the map in ***Larsen*** (1962). For further information about the working up of the material of the three botanical expeditions the reader is referred to the series: *Studies in the Flora of Thailand* edited by the author. This series is published in *Dansk Botanisk Arkiv* (Copenhagen) starting in vol. 20, 1961-63 and continuing in Vol. 23, 1963-.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Soi Dao base
Khao Soi Dao Tai
Khao Gloea
Ban Sattahib
Rayong
Makam
Chanthaburi
Pniu Falls
Khao Sabab
Ban Klong
GULF OF THAILAND

Itinerary and Collection Numbers
1963

5.6.	Chantaburi area (Wen River, Phriu Falls at Khao Sabap)	9733- 9778
6.6.	Makham-Soi Dao	9778- 9823
7.6.	Soi Dao	9824- 9873
8.6.	Soi Dao	9874- 9925
9.6.	Soi Dao	9926- 9964
10.6.	Soi Dao	9965- 9993
11.6.	Soi Dao	9994-10014
12.6.	Soi Dao	10015-10023
13.6.	Plain of Makham	10024-10078
14.6.	Plain of Makham	10079-10114
15.6.	Plain of Makham	10115-10127
17.6.	Bangkok	10128
19.6.	Khao Yai	10129
20.6.	Khao Yai (Khao Khieo)	10130-10233
21.6.	Khao Yai	10234-10309
22.6.	Khao Yai	10310-10348
30.6.	Sai Yok	10349-10366
1.7.	Sai Yok	10367-10418
2.7.	Sai Yok and Thung Kang Yang	10419-10456
3.7.	Sai Yok	10457-10503
4.7.	Sai Yok	10504-10512
5.7.	Thung Kang Yang	10513-10531
6.7.	Thung Kang Yang	10532-10558
7.7.	Thung Kang Yang	10559-10595
8.7.	Thung Kang Yang-Sai Yok	10596-10599
9.7.	Tapoh and Sai Yok	10600-10621
17.7.	Ban Bueng at Cholburi	10622-10646
20.7.	Khao Yai (Khao Khieo)	10647-10699
21.7.	Khao Yai	10700-10727
	Transplants for cultivation in Copenhagen Botanic Garden	10728-10769

Short Description of the Localities Visited

As appears from the preceding survey, the first trip was to the Chantaburi district in the southeastern corner of Thailand. Two areas were here chosen as suitable for the collecting of *Zingiberaceae*, viz. the Soi Dao massif covered with evergreen forests and the Plain of Makham, where sandy podsoled soil alternates with lateriric soil. On the latter a poor dipterocarp forest is met with, while the sandy soil is generally covered with a grass-herb vegetation.

Chantaburi is the main town of the district. It is situated in the centre of very rich rubber plantations (*Hevea brasiliensis*), rubber being the most important crop, the district also famous for its excellent pepper (*Piper nigrum*). Along the coast a broad fringe of mangrove forests is found, highly influenced, however, by man and, as it seems, highly overcut. These mangrove forests are economically important as they yield material for firewood and for charcoal. Southeast of Chantaburi the isolated mountain Khao Sabap rises to more than 3,000 feet, covered with evergreen forest. On the western foothills the Phriu Falls are situated. It was briefly visited during the first botanical expedition in January 1958.

The whole area between Chantaburi and Makham has been brought into cultivation while north of Makham the cultivated land is only a narrow strip along the trail.

The deciduous forest north of Makham is dominated by *Dipterocarpus intricatus* and as subdominants species of *Randia* and *Memecylon*. Along the margin of these low open forests two species are characteristic, the *Dilleniaceae Tetracera loureiri* and a palm belonging to the genus *Licuala*.

The most interesting feature of the Makham area from a botanical point of view, however, is the large sandy plain covered with a large number of low grass species among which such genera as *Isachne*, *Panicum*, *Eragrostis* are richly represented (Fig. 1). The whole area is temporarily covered by water during the rainy season, and immediately after this period a number of small annuals will appear, as was observed in January 1958. Species of *Burmannia*, *Eriocaulon*, *Drosera*, *Xyris*, and of course a rich cyperaceous flora will then be found there On slightly higher and

Fig. 1 Plain of Makam. In the background the Cambodian border mountains.

Fig. 2 Dillenia hookeri from open deciduous forest near Makham.

Fig. 3 From the grassy plain at Khao Yai (2,200 feet) against the evergreen slopes of Khao Khieo, the ridge of which is hidden in the clouds.

Fig. 4 Thung Kang Yang Hills (Phot. during a visit in December 1961).

accordingly drier soil a scrub vegetation is met with, in which *Dillenia hookeri* is dominant (Fig. 2); it is a low species rarely higher than 40 cm. Together with this a beautiful species of *Curcuma* is seldom lacking. This may turn out to be a new species. As other characteristic low shrubs may be mentioned *Melastoma malabathrica* and one or two *Osbeckia* species.

About 40 km north of Chantaburi the mountain massif Soi Dao is situated, which at its highest point, Khao Soi Dao Tai, reaches nearly 5,500 feet. The whole mountain is covered by evergreen forests very little disturbed by man. Only a few places at altitudes about 2,000 feet the underscrub have been cleared in order to make room for the growing of *Amomum krervanh*, the seeds of which species are sold as Siamese cardamom. Twice a year these plantations are visited, once for clearing round the plants and once for collecting the seeds.

The dominating trees in several places seem to be two species of *Dipterocarpus* both evergreen, *D. alatus* and *D. gracilis*, of course mixed with a large number of other species. It would be impossible here to give but the faintest idea of frequencies of the dominating trees or the floristic composition of the forests after so short a visit. A stay on the spot for several months would be necessary to gain sufficient data even for a rough estimation. Some few facts concerning the herbaceous flora, however, may be worth while communicating.

The luxuriant underscrub is mainly dominated by species belonging to the families *Rubiaceae*, *Euphorbiaceae* and *Rutaceae* mingled with several others, e.g. an evergreen species of *Ardisia* which seems to be rather frequent at lower altitudes. The palms are richly represented by the rattans, e.g. species of *Calamus* and *Korthalsia*. The herbaceous flora is nearly all over dominated by the *Zingiberaceae*. What is most striking is the "forests" of the tall species of *Amomum*. These generally reaches a height of about 4 m, sometimes more. *Curcuma parviflora* is common at all altitudes, being one of the commonest *Zingiberaceae* species of Thailand, perhaps all over the country. Of course the genus *Globba* as well as *Boesenbergia* was abundantly represented by several species. Among the *Globbas*, *G. pendula* is most frequently met with; this species is found all over Southern Thailand and is perhaps the most widely distributed *Globba* species in Southeast Asia. One of the most noteworthy

Zinbergiaceae is a basically flowering *Costus* (perhaps *C. tonkinensis* or closely related to it) with a large salmon-pink, funnel-shaped lip.

Among the other families represented in the herbaceous flora may first be mentioned some species of *Acanthaceae*, only two of which were flowering. The *Liliaceae* are represented by the genera *Peliosanthes* and *Ophiopogon*. The grasses are few in these good evergreen forests, here and there *Leptaspis* and *Oryza* were found to be dominants. At foothills, however, bamboos play a great role in the vegetational pattern, but not above 400 m.

From an economic point of view there is no doubt that the whole area from there to Nakawn Nayok is a region which, as soon as adequate communication lines have been established, can be turned into a productive district for different crops, e.g. rubber, lime, and several other fruit-trees. This is what future will certainly also bring along. It is, however, to be hoped that some mountain groups will be protected by nature conservation, among these the Soi Dao massif. There is also another even more interesting group, viz. the Khao Kuap not visited by the author himself, known only from what a few earlier collectors have brought back from trips in the dry season. Khao Kuap, the nearly 6,000 feet high border mountain between Cambodia and Thailand still stands totally undisturbed, covered by evergreen virgin forests. It is still time there to preserve a sample of a true evergreen mountain to generations which will know little else than towns and cultivated land. From a phyto-geographical point of view these mountains are so much more interesting, as the local climatic conditions create a climate similar to that found on the Malay Peninsula. It seems from our investigations that not only the general appearance, but also the floristic composition is strikingly similar to that of the Malayan evergreen forests.

The second collecting area, visited twice at a month's interval, is the Khao Yai National Park east of Saraburi, about 150 km northeast of Bangkok. This is a large area, the plain above 2,000 feet being more than 70 km east-west and 30 km north-south. Above this plateau some high ridges rise, the mightiest of which are the Khao Khieo, 4,200 feet high, and the Khao Laem, the highest point of which is 4,600 feet. On certain parts of the plain shifting cultivation has been managed, but

already several years ago the villages were moved and the lalang grass *(Imperata cylindrica)* spread over these areas (Fig. 3).

Until two years ago the whole mountain group was nearly inaccessible. Only by foot through leech-infested forests one would be able to reach the high ridges after several days. This has left us a botanical *terra incognita* which to day is situated only three or four hours drive from Bangkok. A tolerably good road takes one by car right to the top of Khao Khieo, while Khao Laem still sits unconquered in evergreen majesty without a trail. As a consequence of the extremely high annual rainfall, which is suggested to be about 6,000 mm at the top of Khao Khieo (meaning the Green Mountain), the whole area is covered by evergreen forest.

Also in this case it is quite impossible to give any idea of the floristic composition of the forest vegetation. A few notes, mainly concerning the *Zingiberacea* flora may, however, be communicated.

About 2,500 feet the forest is intersected by several watercourses, and several waterfalls are met with, one of which has the considerable height of approximately 60 feet. On the granite rocks the dried-up remains of a rich flora of *Podostemaceae* could be distinguished. Of course the streams are fringed by an abundance of ferns, among which also some tree ferns were observed. The *Zingiberaceae* flora is extraordinarily rich. Several species of *Amomum* and *Globba* as well as a red-flowered *Alpinia* were recorded. The genus *Cenelophon* is represented by one species with very large fruits, probably this is *C. oxymitrum*, but no flowering specimens were seen. This may be regarded as a northern outpost of the species, and for that matter of the whole genus belonging to the Malayan flora. Furthermore, fruiting specimens of a tall *Catimbium* (probably *C. speciosum*) dominate over large areas.

The days spent at Khao Khieo were extremely exciting for a botanist. The trees are all covered with huge masses of epiphytic ferns and orchids, all boles and branches are green and soft with their thick coat of mosses, *Hymenophyllum* and *Selaginella* species. At the top of the ridge an extraordinary *Zingiberaceae* was found in large numbers in moss on rocks and as an epiphyte. Following a conventional point of

view it can be referred to the *Monolophus* group of the genus *Kaempferia*. It has one astonishing feature, besides belonging to a very rarely found group of species, viz. showing a clinal variation in flower size. This species, new to science, certainly is an old relic endemic to the Khao Khieo. It would be interesting to learn if it is found also on Khao Laem, or if, as may be expected, the group is there represented by another species. Another endemism met with is a *Globba*, perhaps related to *G. garrettii* of Northern Thailand. Species of *Amomum* are often the dominants down the steep hillsides. Other herbs frequently seen are *Chlorophytum orchidastrum*, one or two *Ophiopogon* species, and a marvellous *Acanthacea* which may also be an endemism new to science. In rock crevices several orchids are found, species of *Malaxis* and *Liparis* are frequent, one or two species of *Begonia*, and several *Gesneriaceae*.

Among the trees on the ridge particularly two Gymnosperms were conspicuous, viz. *Dacrydium elatum* and *Podocarpus imbricatus*. This last species was found both in the typical form and in a form with much shorter and narrower leaves.

We must congratulate the Royal Forest Department on obtaining this first real National Park on a large scale, as well as the Government, which has built about 30 bungalows centered around a lake to accomodate visitors. This arrangement is situated in one of the old clearings and does not disturb nature.

It should be emphazised that the Khao Yai National Park is not only a plant paradise, plenty of wild game may be observed as well. All over the area the wild animals are protected all the year round. Driving to the hilltop by night with a spot light sambars and barking deer are always seen, while the wild elephants and wild boars stick to the jungles, several species of bears breed in the thickest, and even the king of the forest, the tiger, can be heard by night. It is beyond doubt that botanists as well as zoologists in the years to come will find scores of species unknown to science—just outside the door to Bangkok.

The third area chosen for the study of *Zingiberaceae* was the Middle Menam Kwae Noi around Sai Yok and Thung Kang Yang.

The surroundings of Sai Yok was described by ***Larsen*** (1962). Since the printing of that report a great part of the material of the Second

Thai-Danish Botanical Expedition 1961/62 has been worked up. Time has shown that this place is even more interesting than first supposed. It may thus be mentioned that among the ferns collected 3 new species have been described, 4 new *Gramineae*, and not less than 16 new *Acanthaceae*. These results have not yet been published but will appear in near future in *Dansk Botanisk Arkiv* Vol. 23.

For the Sai Yok area the rainy season shows that the true dominants among the herbs are the *Zingiberaceae*. Over large areas the forest ground is covered with pure stands of *Globba*, and *Curcuma*, *Boesenbergia*, or *Kaempferia*, while the genera *Amomum* and *Zingiber* seem to be less frequent, and the very tall *Amomum* species so characteristic of the evergreen forests are lacking here in the deciduous and mixed deciduous forests. It has been noted very frequently that squares of 10×10 m were totally covered by *Zingiberaceee* or had only an insignificant admixture of other species, such as *Scleria*, *Cyperus*, *Oryza*, *Chlorophytum*, or some *Acanthaceae*. Most frequently, of course, the cover is less uniform, but it is rare to find a square in which not one or other member of the family *Zingiberaceae* is represented. It is certainly one of the most important families among the ground herbs in most forest types not only there, but all over Thailand, perhaps throughout Southeast Asia.

Another species which is common there as well as in the Thung Kang Yang Hills is a low species of wild banana, often flowering at a height of only 50 cm and rarely surpassing 150 cm when flowering. The inflorescence is erect and the bracts beautifully red; perhaps it may be referred to the Burmese species *Musa laterita*, or it may be an undescribed species.

The Thung Kang Yang Hills all consist of limestone and harbour an extremely interesting flora. Steep escarpments, outcrops and foothill composed of big boulders give these hills a very chaotic look, and often make it extremely difficult to climb. (Fig. 4). At lower altitudes the slopes are covered by mixed deciduous forest rich in bamboo, and apparently these hillsides are exposed to an annual surface fire during the dry season in February-March. Among the many deciduous trees one also finds several evergreen species of which particularly two attract the attention, both belonging to the *Annonaceae*, one of them cauliflorous.

Also there it was the ground flora to which special attention was paid. What was said about the *Zingiberaceae* flora for the Sai Yok forests will on the whole hold good also of the Thung Kang Yang Hills, only that it seems that one finds there a greater variety of species, particularly at the higher altitudes, i.e. above 1,500 feet, where several new species come in. An interesting variation pattern was observed in *Curcuma parviflora*, a variation not observed in other parts of the country and not previously described. Thus it was found that there exists a clear transgression from forms with the typical appearance with the green lower bracts and a white coma to forms with no coma at all and all bracts being green and equal. The species *Boesenbergia longiflora* so common in the hills of northern Thailand is here replaced by a form with smaller flowers of yellow colour. Also other species of *Boesenbergia* were found, e.g. one belonging to the *B. pandurata* group. Species belonging to the *Boesenbergia pulcherrima* group are extremely common, but seem to be flowering considerably later than the other species.

A particularly interesting study was undertaken of the *Kaempferia* species. It was found that *K. galanga* is here replaced by a species with smaller leaves, very narrow lip and corolla lobes. It is certainly a good species, but it is uncertain whether it has been described. *K. elegans* is common from 400-2,100 feet (at any rate). It seems to occur in two varieties. Finally a characteristic also mauve-flowered species is met with on the steep banks composed of lateritic soil along the Menam Kwae Noi.

On lateritic soil in the Thung Kang Yang Forest one species of wild grape is very common (*Vitis hirsuta*). It may be mentioned that in the evergreen forests around the limestone outcrops on the Korat Plateau, e.g. at the foothills of the Khao Yai National Park this species has also been observed. It was told that the local population there used these grapes to make wine.

On the limestone outcrops *Phyllanthodendron mirabile*, *Euphorbia* cf. *antiquorum* and a *Dracaena* species are rarely lacking. At higher altitudes nearly all rocks are covered by moss carpets in which *Selaginella* species play a great role. In crevices *Begonia*, *Chlorophytum*, *Habenaria*, *Liparis*, and other small orchids are common together with several species not yet in flower of *Gesneriaceae*. Three species of white-flowered *Globbas* were collected while the *Araceae* were represented by the genus *Arisaema*, one or two species of *Amorphophallus*, and *Pothos*. Finally two *Dioscorea* species and of course a multitude of ferns complete the general floristic picture of the rock flora at that time of the year.

Fig. 5 Bullockcart used by the expedition to the Thung Kang Yang Hills.

Fig. 6 Tapioca-grinding at Ban Bueng.

Fig. 7 Asplenium nidus in luxuriant evergreen forest on the slopes of Ban Bueng Hills.

Also for this area, which we may call the Sai Yok—Thung Kang Yang Plain, some thoughts concerning its future have occupied the author. As mentioned already in the report on the Second Botanical Expedition (***Larsen*** 1962), the Sai Yok area is extremely suitable for teak plantations on a large scale. As far as the Thung Kang Yang area is concerned, this has an extraordinary rich soil and plenty of water all the year round. It has already been proved that agriculture should characterize the future of this area. Nature conservation may set in to protect the higher hills and particular the Khao Yai mountain massif near the Burmese border (not to be confused by the Khao Yai National Park east of Saraburi). What this area badly lacks today is communication lines. As long as a road serviceable all year round, does not lead to Thasau and even further, the possibilities of this rich plain cannot be properly developed (Fig. 5).

During the last part of the expedition a short trip was made to a mountain situated about 15 km south east of Cholburi. This hill, reaching an altitude of 2,600 feet, consisting of granite, has several times fascinated the author as the first hill one sees when driving southwards from Bangkok. Several such hills consisting of granite and reaching altitudes from 900 to 2,600 feet, are found scattered over the Cholburi and Sriracha plains. On these hills one finds remains of the once vast forests known as the Sriracha Forests by earlier collectors, e.g. Mrs. ***Collins***. Today all the lowlands are cultivated, the most important crop being the tapioca (*Maniht utilissima*), which thrives well on the poor sandy soil (Fig. 6). Also large plantations of coco-palms are seen in this area.

The foothills of the Ban Bueng Hill, as we may call it, are covered by a mixed deciduous forest rich in bamboo. On the ground several *Zingiberaceae* were found to be common, but it had not one species in common with the Sai Yok—Thung Kang Yang forests at the same altitude. The genera *Curcuma*, *Zingiber*, *Boesenbergia*, and *Kaemferia* were richly represented. Some species belonging to other families likewise played a great role in the herbaceous flora, thus *Hypoxis aurea*, *Geodorum* species, and *Chlorophytum* sp. may be mentioned. Of course the family *Acanthaceae* was not lacking; at that time, however, only one species was found to be in flower.

Several small streams drain these hills; one watercourse, forming several small waterfalls, was followed up. Along this *Boesenbergia* and *Catimbium* species were dominating together with *Donax grandis*, and *Caryota* sp. (a low species not more than 6 m tall when flowering). All along the sides of the stream and in the falls an abundance of ferns are met with, particularly *Asplenium nidus* was frequent and might cover

whole rockwalls (Fig. 7). At about 900 feet the evergreen forest, starting as a typical gallery-forest, spreads out and covers the upper part of the hills, apparently due to these mountains gathering a lot of clouds all the year round. Again an example of a suitable study object is situated 2-3 hours drive, only, from Bangkok.

The quickly growing population of Thailand, adding every year about 2,000,000 new mouths to feed, will in the very near future expand all over the lowlands of the country, and the natural vegetation will soon disappear from the lower altitudes. Therefore it is important now to protect certain selected parts of the country which should be really preserved for future students of wild nature and for recreation of the quickly growing population in the towns.

From a botanical point of view this country as well as other parts of tropical Asia is a goldmine in which for many years to come plants new to science will be collected. But as the natural forests are rapidly diminished it is better to collect today than tomorrow. The Royal Forest Department has a large number of suitable stations all over the country, it would be a good idea to let some enterprising young students be stationed for some months every year at these stations for really systematic collecting. This would certainly contribute not only to a better understanding of the distributional types of this interesting flora, but also add considerable knowledge to botany as a whole.

Literlature

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