REPORT
ON THE FIFTH THAI-DANISH EXPEDITION 1966

by

G. SEIDENFADEN, T. SMITINAND and G. THORSON

While the first four Thai-Danish expeditions had largely limited themselves to work in the botanical field, the fifth expedition, which took place from January to March 1966, aimed at scientific explorations in two different fields, *viz.* botany and marine biology. This came about because the botanists this time wanted to centre their investigations on the little known islands along the western coast of the Malay Peninsula between the Burmese frontier at Victoria Point and the Malaysian northern borderline at Langkawi Island. During preliminary discussions with the Thai Government on the question of providing the necessary means of transportation for travel between the islands, it was found that the Government would be very interested in investigations on the marine fauna, and, that a very modern research vessel could be put at the disposal of the scientists by the Thai Fisheries Department. Accordingly, the fifth expedition grew into an undertaking on a much larger scale and scope than the earlier expeditions.

During a preparatory visit to Bangkok and Phuket in June 1965, THORSON and SEIDENFADEN had a series of negotiations with Thai authorities and agreement was reached on all details of the common undertaking. It was agreed that the expedition should have the following objectives:

In the marine biology field:

1) Research work on fish-food animals on the sediment bottoms from a quantitative point of view,
2) Training of groups of young Thai marine biologists,
3) The creation of a broad reference collection of the marine fauna for the use of the Thai Marine Fisheries Laboratory in the future education of marine and fishery biologists.

In the botanical fields:

Continuation of earlier cooperation in extending the knowledge of the Thai flora in general and especially the Orchid flora, at the same time training young Thai students in methods of collection and identification.

The expedition got at its disposal the very modern research vessel M/S Dhanarajata (Pl. VIII), built in 1964, under the command of Lt. Sookasem TRANTRACHIN RTN with a crew of 34 men.

Under the leadership of the Thai Chief Scientist Cmdr. Sawarng CHARENPHOL RTN and the Coordinating Scientist Dr. Arporna SRIBHIBHADH of the Royal Thai Fisheries Department, the following scientists participated in the expedition:

Marine biologists, including students staying part-time on board:

Mr. Urupan BOONPRAKORB,

Mr. Yothin CHANTANARAT,

Mr. Visit CHOMDEJ,

Dr. Victor GALLARDO, The Allan Hancock Foundation, Univ. of S. California,

Dr. B. MUUS,

Mr. Piboon NAINETR, Chulalongkorn University, Bangkok,

Cand. mag. K. OCKELMANN, Marine Biology Institute, Elsinore, Denmark,

Mr. Boonlert PHASUK,

Dr. Rawisak PIYAKARN, Chulalongkorn University Bangkok,

Mr. Manas POTHAROS,

Mr. Vivatanachai PROMSAKHA NA SAKOLNAKORN,

Dr. R. SERENE, UNESCO, Singapore

Mr. Yongyut SINTHUPINYO,

Mr. Damri SOMCHAIWONG,

Professor, Dr. G. THORSON, Marine Biology Institute, Elsinore, Denmark,

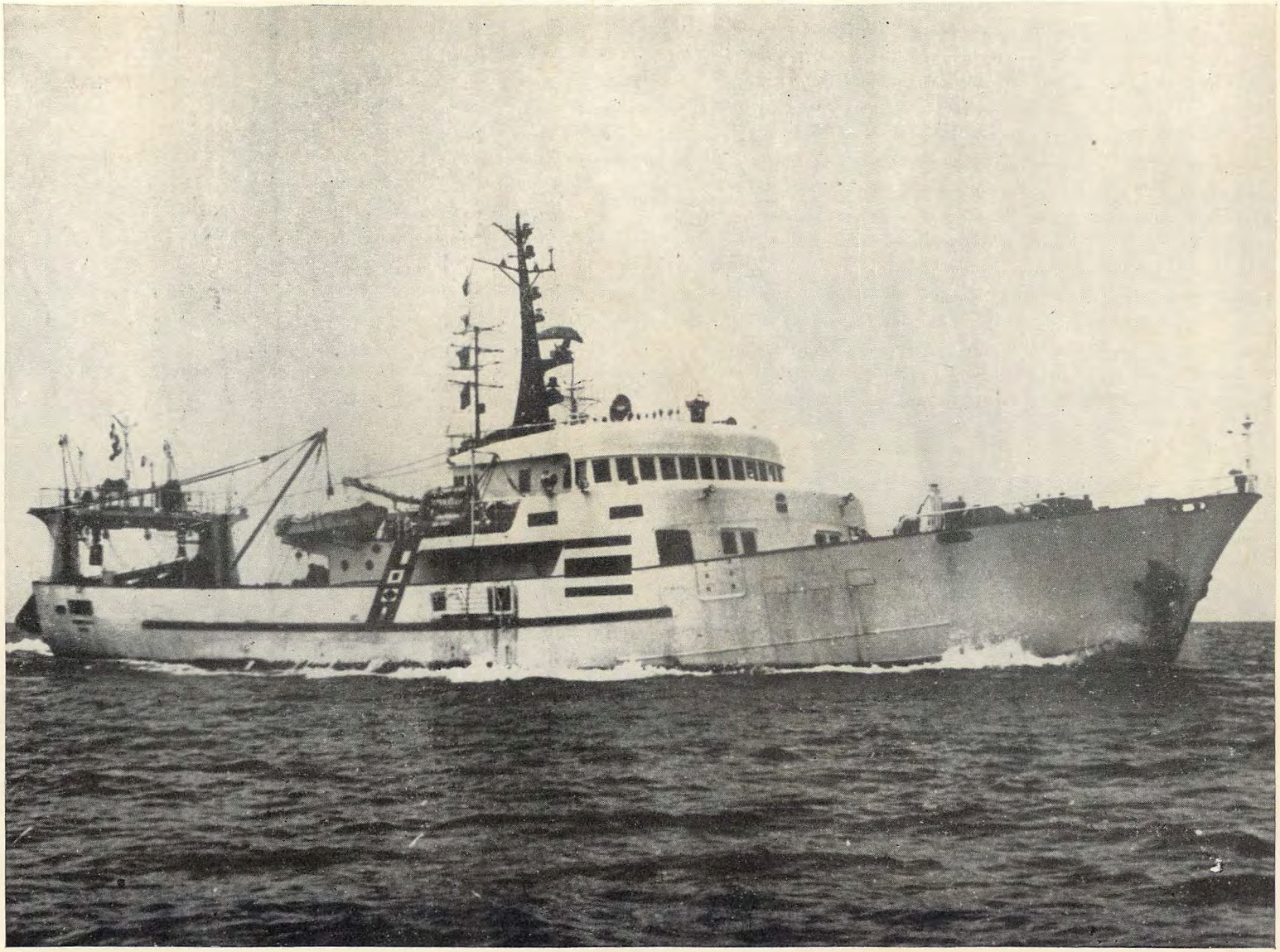
M.L. Prachaksilp TONGYAI,

Botanists:

Mr. H.M. BURKILL, Director, Singapore Botanic Gardens

Cand. mag. Bertel HANSEN, Botanical Museum, Copenhagen

Mr. Arun SAMRUATKIT, Plant Science Div. Dept. of Agriculture, Bangkok,



M/S. Dhanarajata

Mr. Bunnak SANGKHACHANT, Senior plant collector, Forest Dept. Bangkok,

Dr. Gunnar SEIDENFADEN, Botanical Museum, Copenhagen,

Mr. Tem SMITINAND, Curator, Forest Herbarium, Bangkok,

Mr. Sakol SUTHIRASORN, Plant Science Div., Dept. of Agriculture Bangkok,

Mr. Manas SUVACHIPANT, Dept. of Botany, Kasetsart University, Bangkok,

Mr. Amorn UBOLCHOLAKHET, Dept. of Botany, Chulalongkorn University, Bangkok.

Finally, the expedition was joined by Mr. Helge ERNST, Instructor, and Mr. Peter ROOS, Photographer, from the Laterna Film Ltd., Copenhagen, who on behalf of the Danish Government Film Foundation made a documentary colour film of the work of the expedition.

The expedition had its main base in Phuket, where storage rooms were supplied for the expedition at the Fishery Station at Makham. The detailed itinerary will appear from the following reports on the botanical work and the marine biology work. The plan followed was, first, that a general survey of the bottom fauna along the coast was undertaken during the first month of the expedition. during which period the botanists worked on the Peninsula proper (January 4th to February 1st). During the rest of the time, both botanists and biologists worked with the ship as a base, the botanists usually being landed on an island in the morning and fetched back onboard in the evening, while the biologists spent most time gathering material for the reference collection either from the ship or in the tidal zone. Most of February (February 9th to 23rd) was spent in the Phuket Bay. After this, all the scientists were put on shore in a camp established on Terutao Island just north of the Malaysian border while the ship bunkered in Penang. Finally, the last week of the expedition was spent visiting the outer islands between Phuket Island and Victoria Point. On March 10th the ship anchored in Phuket and the collections were packed and sent to Denmark for identification and scientific treatment.

The Fifth Thai-Danish Expedition was made possible through combined efforts by several sources in both countries. We are most

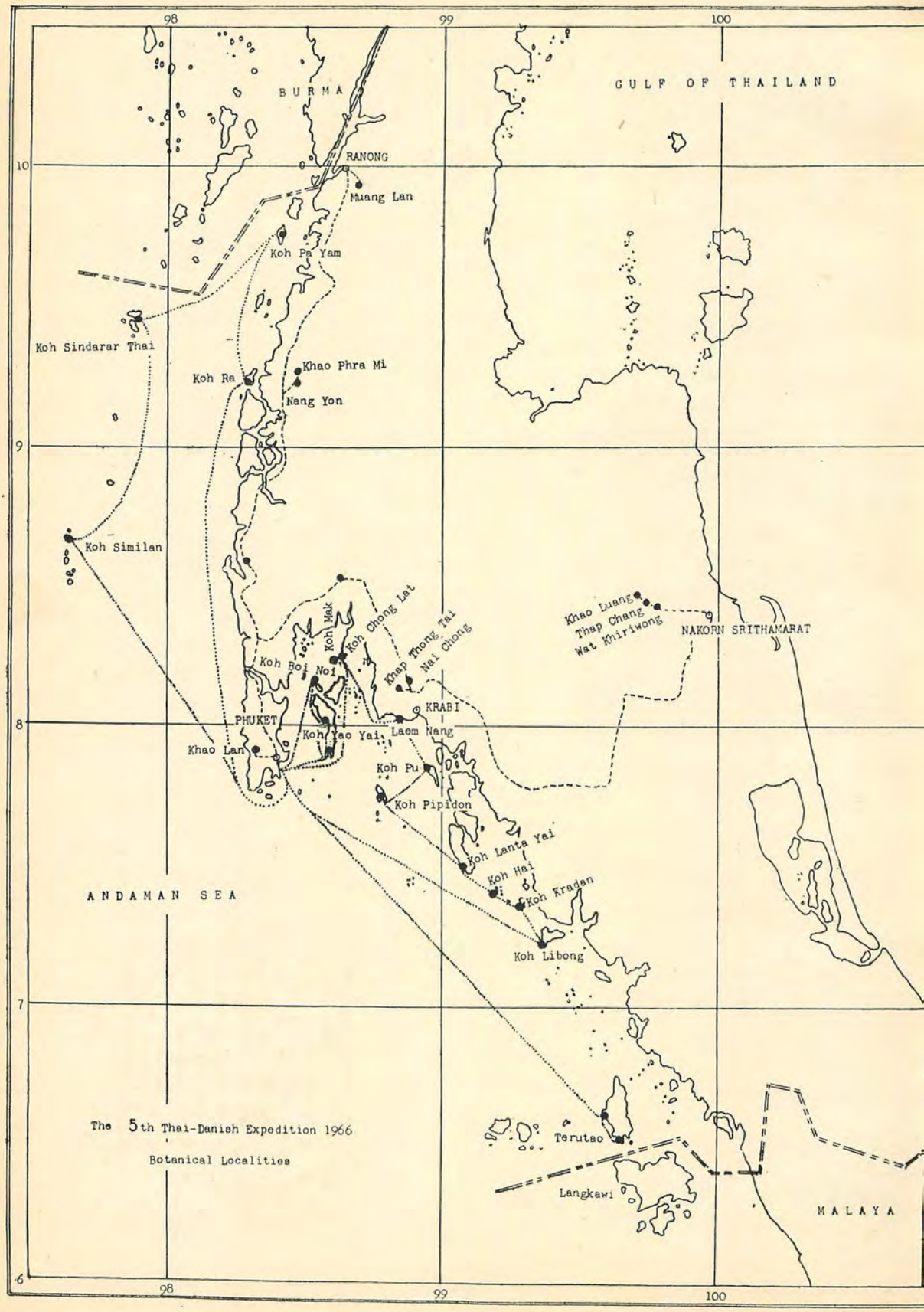
thankful to the Thai Government for the interest shown in supplying the wonderful ship and in granting the considerable funds for the purpose. The Thai Fisheries Department followed closely our work in all details and gave every support. The Thai Forest Department assisted the botanists with the transportation problems, and the local officers of that department were as usual very helpful and hospitable.

On the Danish side the economic base was secured through a large grant from the Carlsberg Foundation for whose constant interest in the Thai-Danish cooperation in the scientific field we are most thankful. We got a lot of assistance from the Botanical and Zoological Museums in Copenhagen. Our very voluminous equipment was transported free of cost from and to Copenhagen by The East Asiatic Co. Ltd., whose officers in Penang were most helpful. And as usual the Danish Ambassador in Bangkok took an active part in our undertaking, and the Director of the Research Centre of The Siam Society gave a helpful hand whenever needed. Finally, we are sure all members of the expedition feel a warm gratitude to the Thai Chief Scientist, Commander Sawarng CHARERNPHOL for the human, diplomatic and firm way in which he undertook the daily leadership of this very mixed bunch of scientists, and his indefatigable efforts to fulfil all our whims and wishes.

The Botanical Work

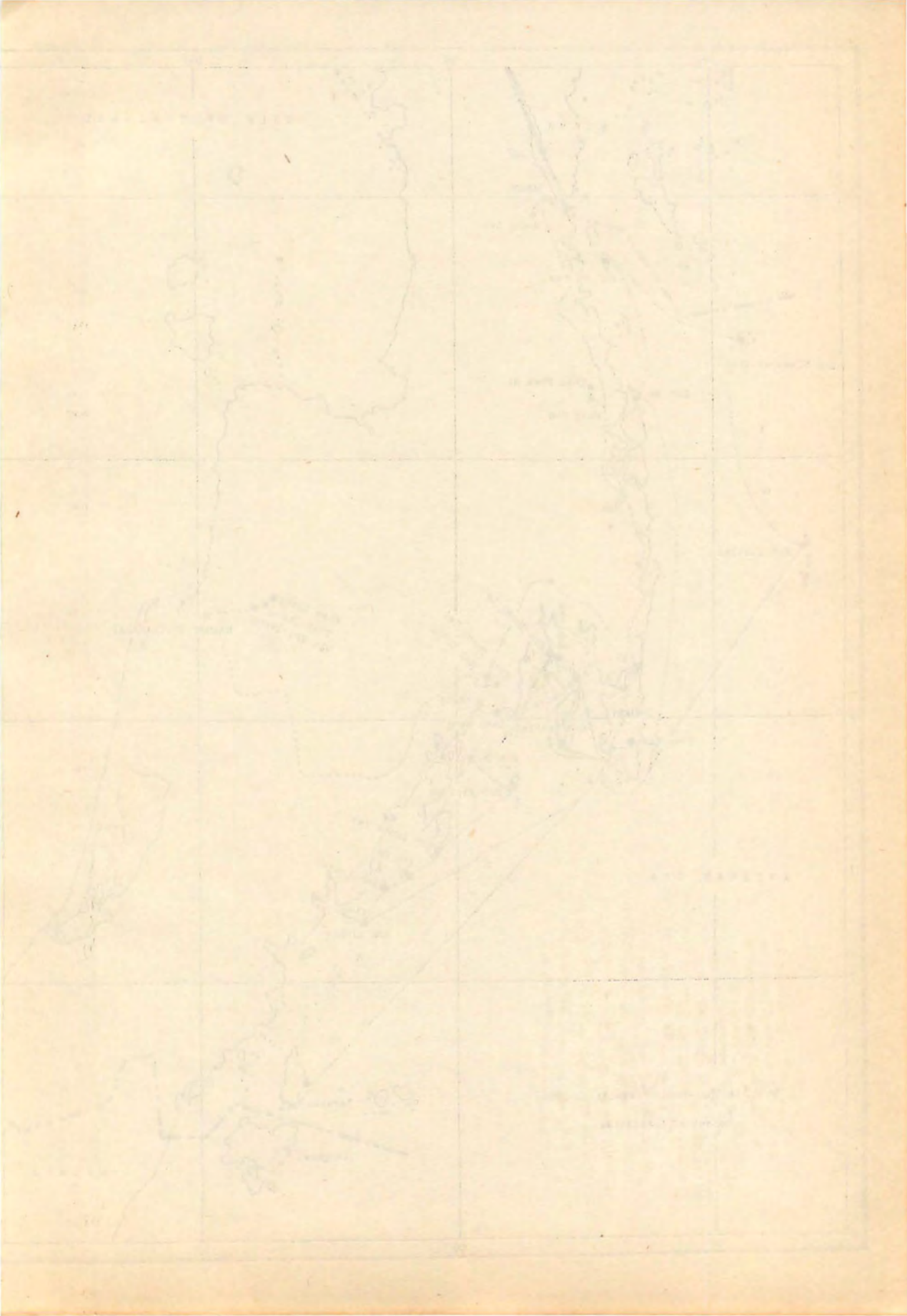
During the month of January 1966 the botanists made two trips on the Peninsula proper. First, using lorries and landrovers, an investigation was made along the west coast from Phuket to Ranong. The trip lasted from January 5th to January 14th, when the party was taken onboard the ship in Ranong and transported back to Phuket. Collections were made in several places along the route, as will appear from the annexed map of botanical localities and the annexed list of localities and collection numbers.

Thereafter, a second trip was made from Phuket across the Peninsula to Nakorn Si Thammarat and from there an attempt was made to get up the high Khao Luang, the highest mountain on the Peninsula. Part of this trip was made on foot with bearers and met



The 5th Thai-Danish Expedition 1966

Botanical Localities



with some difficulties due to heavy rains and difficult terrain; contrary to what is the case in Northern Thailand where the mountains are inhabited, there are no trails in the mountains of the southern part. We had to cut our way in very dense jungle, and the progress was further slowed down by the constant rains and an irritating amount of ticks and leeches. Collections of plants had to be limited, because drying was pretty impossible.

Back in Phuket we returned to the ship and during the period February 9th to 23rd, ten islands and a coastal locality in Phuket Bay were visited. Thereafter, nearly a week was spent on Terutao Isl. and finally short visits were made on the off-shore islands Koh Ra, Koh Pa Yam, Koh Sindarar Thai and Koh Similan, all north of Phuket.

Mr. BURKILL, who took part in most of the trips to the islands, besides a limited collection of higher land plants (his numbers HMB 3971-4015), and the interesting find of a variety of the marine plant, *Halophila decipiens* OSTENF., which was found living in three places in 10m depth and brought up by the zoologists, collected 135 numbers of marine algae on which a publication will appear in this Bulletin.

Generally speaking, the orchid vegetation of the islands proved a disappointment. As will appear from the list annexed, 622 numbers were collected on the mainland and the islands, but many of these are repetitions. The main reason for this may be the inaccessibility of the high-lying areas, both on the islands and on the Peninsula proper, the brush being nearly impossible to penetrate and the cutting of trails on the often very steep hillsides a very time-consuming affair. During our first trip along the west coast from Phuket to Ranong the stay at Khao Phra Mi and Muang Lan gave, however, quite good results, with a rather large number of species; many of them are well known for Thailand, but several will undoutedly prove new to science or new records for Thailand. This is especially true of the many interesting *Bulbophyllums*, where f.i. the very nice-scented *Bulbophyllum lemniscatoides* is new to the Malayan Peninsula, the same is true of *Ceratostylis radiata*, which was also found here for the first time. Both these species were originally described

from Indonesia, on the other hand, the rare *Dendrobium terminale*, also found here as a new record for Thailand, is a northern species.

Also the short excursion to the rainy Khao Luang gave us the impression of a rich and varied orchid flora; many species were found that have not yet been identified, among species new to Thailand could be mentioned *Eria pachystachya*, *Pholidota globosa* and *Galeola javanica*.

On the islands the orchid flora proved uniform and pretty poor in the number of species, it was a rare occasion when more than 10 to 20 species were recorded on a single island. *Aerides odoratum* was very common everywhere along the beaches, the same is true of *Dendrobium crumenatum*, *Ephemerantha kelsallii* and *Ascocentrum micranthum*, quite common were also some species of *Adenoncos*, *Luisia*, *Trichoglottis*, *Cymbidium*, *Eulophia* and *Calanthe*. The search for *Paphiopedilum* was a disappointment, besides a few finds of *P. concolor*, only *P. exul* was flowering profusedly in a single, utterly dry place on nearly inaccessible vertical limestone cliffs overhanging the sea. An interesting find was the yellow-flowered *Taeniophyllum calceolus*, growing on *Hernandia* on the sandy beaches in a few places.

The larger part of the orchids has, however, not yet been identified as the plants were usually not flowering when collected. The publication of the results will take place from time to time together with other new information from other parts of Thailand as the identification work on the plants flowering in the Copenhagen hot-houses proceeds.

The collections made of the flora in general are now being treated by specialists and the results will appear in publications at a later date. On the general survey of the vegetations in the areas visited the following preliminary account may be given (by Tem SMITINAND):

The first investigations were centered around Khao Phra Mi, the highest peak in a continuous mountain range forming the eastern border of Koh Kho Khao, a district of Phang-nga about 180 km north of Phuket. The forest in the lowlands is the Tropical Evergreen type and is an intermediate between the Semi-evergreen and the Tropical Rain forest. The impact of man can be seen by old clearings

and savannas due to mining in past decades. Dominant tree species are *Lagerstroemia speciosa, L. floribunda, Dillenia obovata* and a species of *Eugenia; Markhamia pagetii* is scattered throughout and was in bloom. Along the stream east of Khao Phra Mi a gallery forest is formed by *Knema sphaerula, Elaeocarpus robustus, Dipterocarpus kerrii* and *Vitex pinnata.*

In the upper reaches of this stream at about 200 m altitude, the slopes are covered with Tropical Rain forest, where *Dipterocarpus kerrii* is dominant with a very good regeneration; *Dipterocarpus grandiflorus* is found here and there. Other species, such as *Parashorea stellata, Neesia javanica*, a species of *Calophyllum* and a species of *Lophopetalum* are also frequent. On higher slopes, at about 300 m altitude, *Shorea gratissima* is frequent and was in bloom, here also are *Durio penangianus, Hopea latifolia, Heritiera perakensis, Duabanga grandiflora, Cinnamomum impressinervium, Tetrameles nudiflora, Shorea farinosa* and a number of species of the genera *Canarium, Artocarpus, Ryparosa, Calophyllum* and *Syzygium. Dipterocarpus kerrii* stops at this elevation and is replaced by *Dipterocarpus grandiflorus.*

On the southern ridge of Khao Phra Mi at about 400 m altitude the forest is more open and drier. Tree species are *Dipterocarpus grandiflorus, Mesua ferrea, Parashorea stellata, Neesia javanica, Swintonia griffithii, Hopea* sp. and *Michelia* sp. At the height of 500 m the dipterocarps are represented by *Dipterocarpus grandiflorus,* and *Parashorea stellata*; *Swintonia griffithii* is abundant, other associates are *Acer oblonga, Mesua ferrea* and *Lophopetalum* sp. All these trees have straight, tall stems. The soil on these ridges is yellow sandy loam to gravelly.

At the altitude of 540 m the vegetation changed abruptly as the ridge became very narrow and steep-sloped with outcrops of granitic boulders. Trees are stunted and crooked, of 4-5 m height, dominant species are *Tristania rufescens* and a species of *Syzygium.* The ground was covered by a davalloid fern of the genus *Oleandra.*

The next locality visited, Mueang Laen, Ranong, is a mining village about 15 km south-east of Ranong, with Khao Nom Sao as the highest peak of the area. As in all mining areas, the forest was very

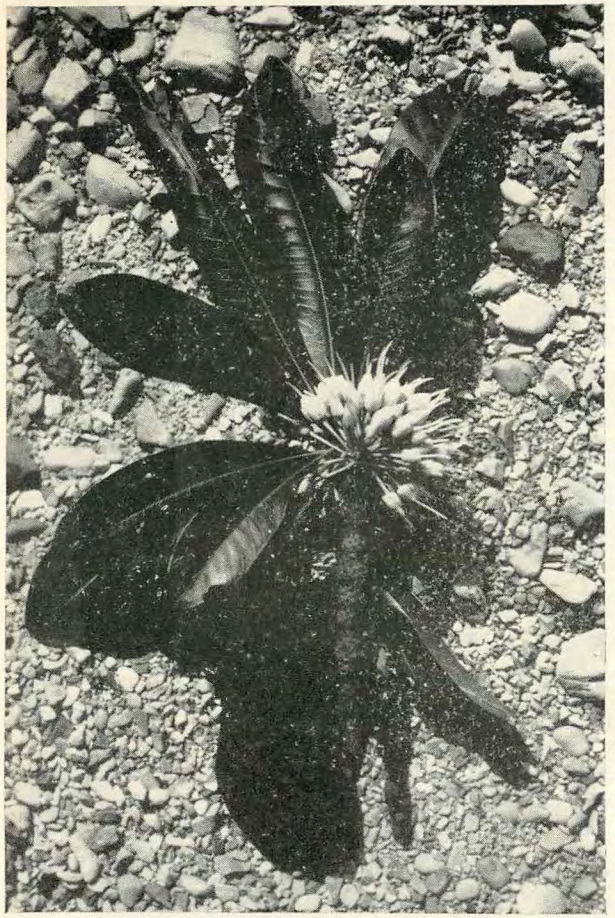
much disturbed and reduced to secondary type. Tree species found in the lowlands are *Dillenia obovata*, *Quercus semiserrata*, *Anisoptera scaphula* and *Lithocarpus* spp. The undergrowth is dense with tangled masses of straggling ferns, *Gleichenia norrisii* and *Dicranopteris linearis*. On the slopes and ridges, where erosion is immense, *Tristania merguensis* and species of *Castanopis*, *Dillenia* and *Syzygium* are frequent; the undergrowth is dense with low shrubs, tall grasses and sedges.

An attempt was made to visit Khao Nom Sao, but as there was no local guide available, the party could only reach an altitude of 240 m, where the Tropical Rain forest is rich in species and similar to that of Khao Phra Mi. In this vicinity we came across *Gnetum gnemon*, found abundantly on low ridges.

Khao Luang, our main locality near the eastern coast of the Peninsula, which is the highest peak in the mountain range reaching an altitude of some 1700m, is located in the district of Lan Saka in Nakhon Si Thammarat. The whole range is well covered with Tropical Evergreen forest, which can be divided into two zones: The Tropical Rain forest from the foot-hills up to 1000 m, and the Lower Montane forest from 1000 m upwards. In 1963 the forest was partly destroyed, especially on the southeastern slopes, by a hurricane.

The Tropical Rain forest is rich in dipterocarpaceous species and may be referred to the Malaysian Lowland Dipterocarp forest; the following species are frequent: *Dipterocarpus kerrii*, *D. gracilis*, *D. grandiflorus*, *Shorea farinosa*, *S. gratissima*, *Parashorea stellata* and *Hopea odorata*. Non-dipterocarps are represented by the following genera: *Calophyllum*, *Durio*, *Lithocarpus*, *Castanopsis*, *Aglaia*, *Chisocheton*, *Amoora*, *Mesua*, *Palaquium*, *Kayea* and *Syzygium*. The undergrowth is dense, consisting of low shrubs, zingiberads, rattans and ferns.

The Lower Montane forest is very dense, and tree species are rather stunted and crooked, especially on the higher elevations. Between 1000 and 1300 m altitude, *Lithocarpus* is the main element. *Rhododendron taiense* is found frequently throughout and was in flower during our visit, an epiphytic ericaceous species, *Vaccinium viscifolium* was also in bloom. The undergrowth is composed of low shrubs, sedges and ferns. *Dipteris conjugata* and *Cheiropleuria bicuspis*



Type specimen of *Aesandra krabiensis*, beach of Laem Nang.

Hernandia peltata at Koh Pipidon.

Cycas rumphii, male cone, Koh Pu.

are found frequent among other terrestrial ferns. Epiphytes are abundant and composed of orchids, ferns, mosses and lichens.

The vegetation on the islands of the west coast, which was the object of the second half of our investigations, is generally speaking of the Malaysian floristic affinity, as can be discerned by the rich Lowland Dipterocarp forest. Most of the islands belong to the granitic formation, only a few, such as Koh Pipidon and part of Terutao are limestone. The granitic islands, such as Koh Talibong and Koh Yao Yai are well populated, while Koh Pu and Koh Terutao are not yet opened for settlement. The following descriptions of Koh Pipidon, Koh Pu and Koh Terutao may give a general idea of the vegetation in the granitic and limestone formations.

Koh Pipidon is a massive limestone hill with precipitious cliffs, sparsely covered with trees and shrubs. Along the sandy beaches *Hernandia peltata, Cordia subcordata, Pongamia pinnata, Ficus microcarpa, Thespesia populnea* and *Barringtonia asiatica* form a narrow strip. On the limestone hill, *Pentacme suavis* is abundant, while *Atalantia monophylla* is frequent along the foot-hills; a species of *Celtis* is found scattered along the cliffs. In a well-protected cove *Pterospermum littorale* and *Xylocarpus granatum* were found.

The vegetation of Koh Pu is almost intact as the island has been declared a reserved forest. The forests belong to the Lowland Dipterocarp and Mangrove forest types. In the Lowland Dipterocarp forest *Dipterocarpus grandiflorus, D. costatus, Parashorea stellata, Shorea farinosa, S. gratissima* and *Anisoptera scaphula* are frequent. *Dipterocarpus grandiflorus* and *D. costatus* are tapped for wood-oil.

In the Mangrove, *Avicennia alba* and *A. officinalis* form an outer fringe, whereas *Bruguiera hainesii* and *Ceriops tagal* are scattered along the edge of the Lowland Dipterocarps. Other mangrove species are *Rhizophora apiculata, Scyphiphora littoralis, Aegiceras corniculata, Lumnitzera coccinea, Sonneratia alba, Heritiera littoralis* and *Aerytera littoralis.* It is interesting to see *Peltophorum pterocarpum* growing along the edge of the Lowland Dipterocarp forest by the sea. The tree itself is quite old and moribund, usually of about 200 cm in girth and about 20 m in height, the basal part of the stem is always

hollowed leaving 5-6 ligneous parts to support the stem. *Cycas rumphii* is abundant along the shore both on sandy and rocky soil together with *Cordia subcordata.* On the slopes the palm *Livistona* is not uncommon, and one can see a beautiful stand of *Dipterocarpus costatus.*

Koh Terutao has once been a prison camp and the forests in the lowlands have been cleared and have become a secondary type. Along the beaches near West Point, where the camp was established, *Melaleuca leucadendra, Vaccinium bracteatum, Syzygium gratum, Garcinia sp., Pandanus tectorius, Lindera sp.* and *Cinnamomum iners* form dense stands together with the shrubby *Spirolobium cambodianum, Dodonaea viscosa* and *Styphelia malayana.* On the raised sandy ground cushion-like formation of mosses are frequent. *Casuarina equisetifolia* is found scattered along the sandy beaches. *Cycas rumphii* is not uncommon among the thickets in the lowland. Along the estuaries of streams, *Ceriops tagal, Rhizophora apiculata* and *R. mucronata* form the Mangrove forest.

In the Tropical Rain forest which cover the upper reaches of the streams, *Shorea farinosa, S. parvifolia, Dipterocarpus grandiflorus, Hopea odorata, H. latifolia* and *Vatica cinerea* are found together with *Buchanania, Syzygium* and *Polyosma.* The undergrowth is formed by low shrubs such as *Randia, Phyllanthus, Glycosmis, Ardisia* and palms of the genera *Licuala* and *Pinanga.*

The Marine Biology Work

(by G. Thorson)

As already mentioned in the introduction, this part of the expedition had a scientific main-purpose, but at the same time should be a help towards training young Thai marine biologists in some of of the modern types of research.

The scientific scope of our expedition was to find out which animals and how much animals are living on the sandy and muddy bottom areas off the west coast of Thailand or, in other words, how much fish-food was present per square meter of bottom.

Beach forest of Koh Rah. *Cycas rumphii*, *Planchonella obovata* and *Morinda citrifolia*; dark-stemmed trees are *Casuarina equisetifolia*.

Styphelia malayana on a cushion of moss (*Leucobryum*), Terutao.

Beach vegetation of Koh Rah.
Casnarina-Barringtonia-Scaevola formation.

Vegetation on a rocky head land of Koh Pa yam.
Plauchonella-Terminalia Tristania formation.

For this purpose we used the Smith-McIntyre bottom grab, which with its jaws will "bite" one tenth of a square meter out of the bottom and bring it up with all the animals enclosed. The annexed map will show the area which we explored. Each point in this map indicates a station in which ten grab hauls were taken. Stations of this types were dispersed as equally as possible over an area of about 7000 square km from the frontier of Burma to the frontier of Malaysia. Our 420 grab hauls are fairly equally distributed over all depths from quite shallow water to about 80 m. The Smith-McIntyre grab worked so well that on an average 8 liter of bottom substratum was brought up in each grab haul. This will mean that the grab on an average has brought up all animals down to 8 cm below the surface of the bottom, and from a bottom area of 42 square meter, making a total volume of about 3600 litre of sand and mud. All this bottom substratum has been carefully sifted through 2 mm mesh screens and all material retained by these screens has been sorted by the biologists bit for bit to pick out all animals contained. Then these animals were sorted, identified as much as possible, and preserved for further, more detailed, studies. Also, sediment samples were taken from all grab hauls for later analysis of the grain sizes and organic content.

In the area round Krabi a special survey was carried out. In the very shallow water here, 50 grab hauls, all from depths less than 8 m, were collected by a special technique which allowed us to use the fairly heavy grab in quite shallow water. This survey will be specially treated to compare with the results from deeper water.

The method of taking quantitative grab hauls, even when used with the greatest care, is of course a rough method, since all animals smaller than 2 mm will pass the screens and be lost. To compensate for this, the grab hauls were followed by samples of another instrument, "the mouse-trap", invented by one of the participants of the expedition, Dr. Bent Muus. This instrument, or one which might serve the same purpose, had never before been used in any tropical shallow water area so far. It will bring up all animals down to 0.25 mm size from the two uppermost cm. of a bottom area of 1/50 sq. m. Usually, we took two mouse-trap hauls together with 10 Smith-McIntyre grab

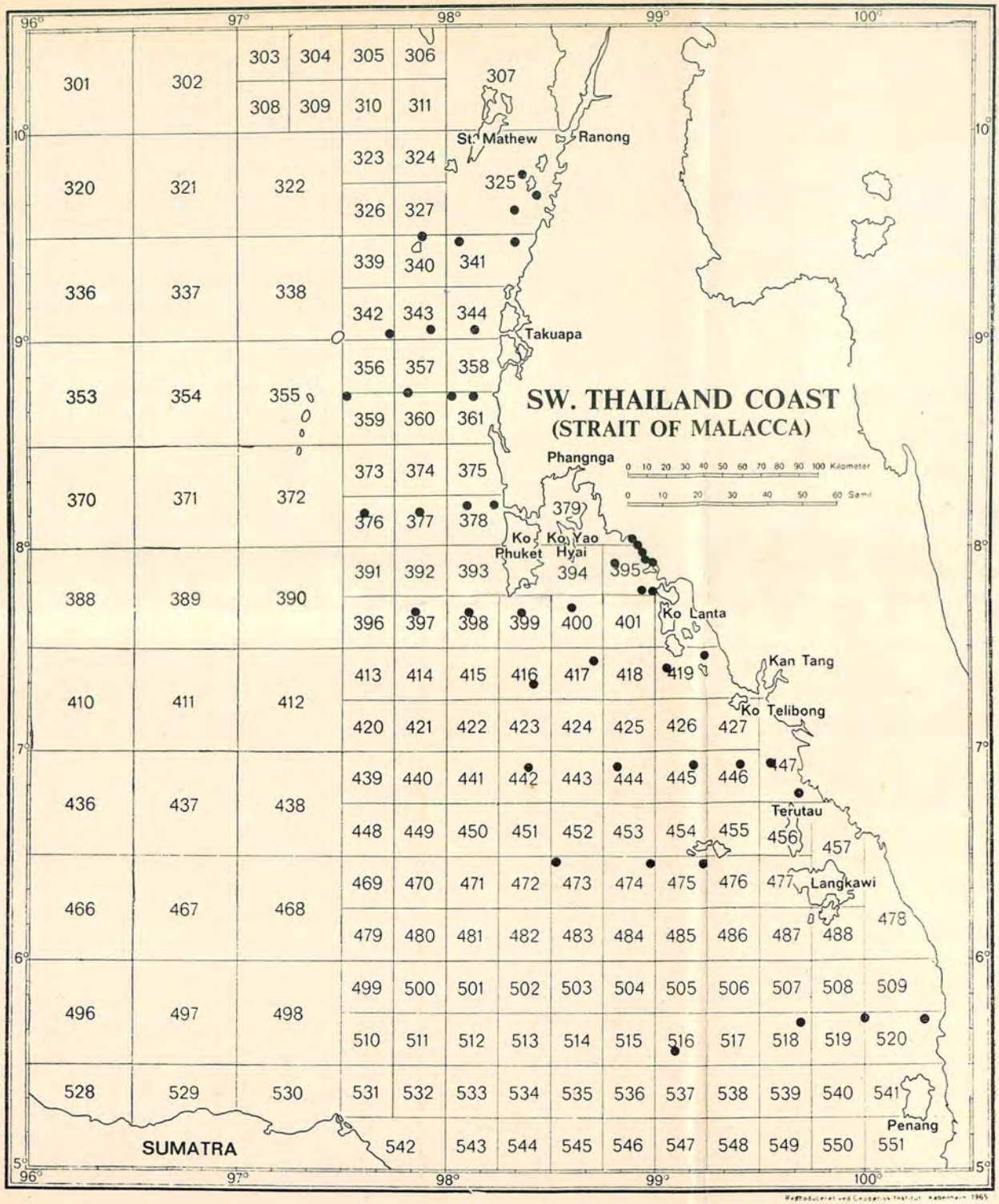
hauls, and we have a total of about 75 quantitative samples of these small animals, the so-called "meiofauna", from the whole area. Today, more than one and a half year after the sorting of these samples were started in Elsinore, our technical assistants are still working on these samples. The first sample took one full month for a trained technician to sort, and by now about 25 samples have been finished. It is our intention to sort out one mouse-trap haul for each 10 Smith-McIntyre samples since this will give us important information on the upgrowth and the productivity of the area.

Besides using these quantitative methods, the expedition has made 37 shore collectings, partially by skin-diving, comprising such localities as rocks, sandy beaches, mangrove swamps and different types of coral reef, have made 30 dredge hauls with a special triangular dredge and also some collecting of animals attracted to the surface by artificial light at night. Furthermore, the "Dhanarajata" has undertaken about 30 trawl hauls during the same period, and at several occasions samples of bottom-detritus with its content of microscopic animals were studied alive onboard the ship.

Having now presented the area of investigation and the way in which our material was collected, it seems reasonable to give a short, preliminary report about the results obtained.

As concerns the number of species of animals, the Thailand west coast must be considered as one of the richest areas of our globe. By far the greatest number of these species belong to the epifauna, i.e. they live on rocks, stones, coral reefs etc. We are, however, more interested in studying the infauna, i.e. the animals which are dug down in the sandy or muddy bottoms, simply because bottom areas of these types cover by far the largest surface of the bottom along this coast and thus will be more important for the upgrowth of fish food.

In temperate and some tropical areas of the sea, only a few species are really quantitatively frequent on the sandy and muddy bottoms, where each of these species will occur in a large number of individuals. So, in the Danish seas, we will have a community on the sandy bottom where up to several hundred individuals of 2 or 3


SW. THAILAND COAST
(STRAIT OF MALACCA)
SUMATRA
St. Mathew
Ranong
Takuapa
Phangnga
Ko Phuket
Ko Yao Hyai
Ko Lanta
Kan Tang
Ko Telibong
Terutau
Langkawi
Penang
96°
97°
98°
99°
100°
10°
9°
8°
7°
6°
5°
0 10 20 30 40 50 60 70 80 90 100 Kilometer
0 10 20 30 40 50 60 Sami

species of lamellibranchs (mussels) will fully dominate on the bottom. We, therefore, were surprised to find the opposite to be the case along the West Thailand coast, where the sandy-muddy bottoms are inhabited by a large number of species with only a few individuals of each.

The small weights of the animal-population per square meter was a most surprising result, the more so since the area is so extremely rich in species. Thus 80% of all our grab hauls gave a weight between 0 and 10 g animals per sq.m, 9% a weight between 10 and 20 g animals per sq.m. and only 8% a weight between 20 and 50 g per sq.m. This will mean that only 3% of all grab hauls contained an animal weight of more than 50 g per sq.m. The corresponding *average* weight in cold temperate seas will be 250 to 300 g per sq.m, i.e. 5 to 6 times higher than the weight of 97% of all samples from western Thailand!

The general tendency is that the number of animals will decrease with increasing depths. Our preliminary countings show that on an average we have 11 species, but only 17 individuals per grab haul, or less than 2 individuals of each species in an area of 1/10 sq.m. In our station 1018 (about midway between Takuapa and Ranong, at 15 m depth, with loose, brown sand), for which a special analysis has been made, the 10 grab hauls comprised a total of 94 species of animals of which 60 were only present in 1 or 2 individuals.

Our next question was how the number of s p e c i e s was distributed on the different types of sandy and muddy bottoms. Without going into details it can be roughly stated that most species are associated with the sandy bottoms, and that the bottoms consisting of pure mud are always very poor in animal species. Thus, all samples which contained a number of animals corresponding to more than 5 g per sq.m. were taken on sandy or gravelly substrata. A similar plotting out of the number of i n d i v i d u a l s associated with sandy and muddy bottoms will show the same tendency, but still stronger. The sandy bottoms are by far the richest, the muddy bottoms being very poor.

The worms, and especially the polychaetes, will make about 73% of all individuals in our samples. Next come, and this is the most important, the shrimps and prawns (8.3%), then follows the

crabs (8%, and no less than 68 species), and finally some small lobster-like crustaceans (6%), which can not be exploited commercially.

Having already seen that the number of animals and their living weight per sq. unit of bottom is very small as compared to the fauna living under corresponding conditions in cold temperate seas, the next question will be: how is the p r o d u c t i v i t y? In other words, how quickly will a new generation grow up and mature in Thai waters as compared to the more cold areas of the ocean. Here the "mouse-trap" hauls will be of much importance for our final evaluation. If we compare the number of animals less than 2 mm in size, which so far have been sorted out from our Thai-expedition samples, we will find that their number per 10 sq. cm will range from only 25 specimens at depths less than 20 m to as little as 4 specimens at depths between 76 and 78 m. If we compare these figures with those from similar samples in European and North American-Atlantic areas, we will see that the Thai samples are no less than extremely poor. While samples taken off Scotland may comprise 536 to 3117 specimens per 10 sq. cm, those from the French coast off Roscoff 615 to 1210 specimens per 10 sq. cm, and those from the USA New England coast 235 to 988 specimens per 10 sq. cm, will the Thai samples with only 4 to 25 specimens per 10 sq. cm be comparable to the very poor conditions along the brackish water coast of Finland (4 to 103 specimens per 10 sq. cm) which are the lowest figures known so far. Even the existing figures of a similar size of animals from the tropical deep sea (Indian Ocean, Meteor Expedition) will show higher figures: 16 to 170 specimens per 10 sq. cm, than the shallow water samples from western Thailand.

This again indicates that the productivity along the Thai west coast is a poor one. It may be, of course, that the main settling of spat and fry of the fish food animals will take place at another time of the year than that during which our samples were taken (January to the middle of March), but many of our observations tend to show, that the average upgrowth for many species in Thai waters is not much quicker than in cold temperate seas.

The small number of individuals of each species will further make it difficult for bottom feeding fishes, especially flat fishes of the flounder type, to find enough of their favourite food, and the trawl

hauls also show that this type of fishes, which in cold temperate seas make an important part of the fishery, are very scarce off western Thailand and will never be able to make a basis for a prolific fishery.

Much more promising are the chances for a succesful prawn and shrimp fishery. The shrimps have a mode of feeding which will allow them to exploit the bottom fauna of western Thailand to its full extent. In temperate seas we will on an average only catch at height 1 shrimp per 2 sq. m in our grab hauls. Off western Thailand our grab hauls gave close to 10 shrimps per sq. m, i.e. 20 times more, and in the richest shrimp areas we had 30 to 37 shrimps per sq. m. Again here, the sandy bottoms in shallow water give the highest yields. Six to seven species of shrimps are involved in these catches, among them young specimens of species which are known to grow to full size of 12 to 14 cm probably in one year or less. All the larger specimens will be much too quick to be caught by our clumsy grab. So we only get the smaller ones, but among them also the young stages of the large species. It may be that the tropical shrimps are all in all more slow in their movements than the cold temperate ones, so that in cold temperate seas more shrimps will escape from the grab. But even if this is considered it can be taken for granted that there are much more shrimps on the Thai bottom areas than in cold temperate seas. Again here, especially the sandy bottoms in shallow water will comprise rich populations of quickly growing shrimps and prawns, which may in the future be exploited commercially.

All in all, our grab hauls show that the quantity of animals as well as the productivity per time unit is much richer in quite shallow water than at depths larger than 10 m. Observations on the quick growth of the pearl oyster in such shallow water and of the plankton production here as compared to that of the open sea, clearly shows that it will be wise to concentrate any economical efforts for shrimp and oyster cultures in quite shallow water and preferably in areas where the bottom consists of coarse sand.

Besides carrying out this strictly scientific research programme, the 5th Thai-Danish Expedition also had other duties. One of these was to bring together material for a reference collection, which after identification by specialists preferably of the Copenhagen

Zoological Museum, may by and by be sent back to Thailand to make a basis for further studies by scientists and students. The crabs have already been worked up by Dr. R. SERENE in Singapore. Dr. Jørgen NIELSEN, Copenhagen, is at present working on the fishes and tells us that the collections we brought back are the best preserved which the Copenhagen Zoological Museum has ever received apart from those obtained by the Galathea Expedition.

Best of all will be when young Thai Biologists can be personally trained in working up the material from the expedition. This has already been possible for three groups of animals, as three Thai biologists have been given UNESCO fellowships for work at the Elsinore Marine Laboratory in Denmark. Mr. Phaibul NAIYANETR has worked up the shrimps, Mr. Boonlert PHASUK the polychaetes and Miss Somphorn SRIYAKORN the echinoderms. It should be possible very soon to start sending back safely identified material for the reference collection.

Finally, during the expedition, the idea came up to start a Thai-Danish Marine Biological Centre close to Phuket. This centre would be a training institute in basic marine biology for Thai biologists and perhaps later also for UNESCO fellows from other parts of Asia. The center should also run its own scientific research programme. Although this idea was only a dream at the time of our expedition, we nevertheless used a week to examine 10 different localities comprising coral reefs, sheltered and open sandy beaches and mangrove swamps, which might be reached in half an hour by boat or car from the place where the planned centre will be located. Preliminary descriptions of these localities were worked out and they show that so many and varied localities can be reached within a short distance that the basis for a rich and prolific research programme is present.

Since then, discussions have been going on between Thai and Danish authorities the result of which is a treaty on cooperation in establishing and running a marine biological centre near Phuket which was formally signed by the two Government on October 16th, 1968.

List of botanical localities and collection numbers

	Date	Geogr. pos. N. lat.	E. long.	Collection numbers Orchids:	Other:
North of Thung Maphrao, km 56	6.1	8°37	98°14,5	6001	— —
North east of Nang Yon (campsite)	6.1	9°13,8	98°27,8	6002–06	— —
Eastern foothills of Khao Phra Mi	7.1	9°15,7	98°27,7	6007–68	11800–11828
South east slopes of Khao Phra Mi	8.1	9°15,8	98°26,6	6069–95	11829–11848
North east of Nang Yon, along river	9.1	9°13,8	98°27,8	6096–36	11849–11872
Muang Laen south east of Ranong	11.1	9°55,6	98°41,4	6137–91	11873–11917
West of Muang Laen 100-300m	12.1	9°55,5	98°41	6192–11	11918–11935
South east of Muang Laen	13.1	9°55,4	98°41,5	6212–15	11936–11968
Nai Chong, Krabi	18.1	8°11,5	98°50	6216–29	11969–11996
Khap Thong Tai, Krabi, 20m	19.1	8°11	98°47,6	6230–56	11907–12018
West of Ban Khao Thong, Phangna 80m	20.1	8°32	98°37	6257–63	12019–12042
West of Wat Khiriwong 3-500m	23.1	8°26,5	99°46	6264–66	— —
Khao Luang Base Camp 750m	24.1	8°28,5	99°43,3	6267–73	12043–12046
Khao Luang, southern slope 750-1000m	25.1	8°28,5	99°45	6274–20	12047–12081
Khao Luang, southern slope 1000-1350m	26.1	8°29	99°45,4	6321–50	12082–12107
Khao Luang Base Camp 750m	27.1	8°28,5	99°44,3	6351 - 66	12108–12132
Thap Chang	28.1	8°28	99°44	6367–80	12133–12148
Thap Chang, along river	29.1	8°28	99°44	6381–11	12149–12171
West of Wat Khiriwong 130m	31.1	8°26,2	99°46	6312–13	12172
Sand dunes near Phuket Airport	5.2			—	12173–12183
7km north of Phuket town	6.2	7°57	98°23,5	6417	12184–12189
Khao Lan, east of Ban Karon 160m	3.2	7°49,5	98°19	6414–15	12190–12194
Ban Laem Phap Pra	6.2	7°52	98°26	6416	— —
Koh Libong	10.2	7°12,7	99°22,7	6420–26	12195 - 12222
Koh Kradan	11.2	7°19,3	99°15,2	6427–29	12223–12230
Koh Hai	11.2	7°24	99°12,7	6430–33	12231–12248
Koh Lanta Yai	12.2	7°29,5	99°05	6434–37	12249–12284
Koh Pipidon	13.2	7°44,2	98°46,2	6438–41	12285–12302
Koh Pu	14.2	7°50,7	98°57	6442–62	12303–12341
Laem Nang, Krabi	16.2	8°00,5	98°51	6463–80	12342–12352
Koh Chong Lat	17.2	8°17	98°37,5	6481–95	12353–12358
Koh Mak	18.2	8°17,5	98°36	6496–02	12359–12372
Southern tip of Koh Yao Yai	20.2	7°54,2	98°34,9	6503–06	12373–12396
Ao Labu, Koh Yao Yai	21.2	8°01,4	98°34,5	6507–14	12397–12428
Koh Boi Noi	22.2	8°10,3	98°32,5	6515–25	12429–12439
Koh Terutao, north of West Point	26.2	6°37	99°37,4	6526–48	12440–12449
Koh Terutao, north of West Point	27.2	6°37	99°37,4	—	12450–12477
Koh Terutao, south eastern coast	28.2	6°31,6	99°40,2	6549–58	12478–12493
Koh Terutao, West Point	1.3	6°36,6	99°37,6	6559–73	12494–12510
Koh Terutao, West Pt. south of river	2.3	6°36,6	99°37,2	6574–82	12511–12529
Koh Ra	5.3	9°12,5	98°17,2	6583–02	12530–12545
Koh Pa Yam	6.3	9°45	98°25	6603–11	12546–12555
Koh Sindarar Thai	7.3	9°26,5	97°52	6612–17	12556–12557
Koh Similan	8.3	8°39	97°38,5	6618–22	12558–12569