THE FAUNA OF DURIAN AND THE RHIO-LINGGA ARCHIPELAGO.

By

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I. The Fauna of Durian.

After we had studied the new fauna of Krakatau we looked for an island not devastated by volcanic eruptions during at least the last centuries in order to compare the two. First we considered the island Sebesy lying quite north of Krakatau but, as already mentioned in our previous paper (Treubia Vol. III, 1) we found that the fauna of Sebesy was also destroyed to nearly the same extent as that of Krakatau by the terrible catastrophe of 1883. The other islands in the Sunda Straits had also suffered more or less from the same disaster, so we had to look still further afield for an island about the same area as Krakatau and still in normal condition. In the western part of the Java Sea and near Billiton and Banca all islands about the same size as Krakatau proved to be too low or too cultivated, so it was not before we came to the Rhio-Lingga Archipelago that we found an island satisfying to some extent the necessary conditions. As the island of Durian has about the same area as Krakatau and is placed between the bigger island of Sumatra and the Malay Peninsula (just as Krakatau is situated between Java and Sumatra) it seemed to be suitable to our purposes. Moreover, the whole island is clad with virgin forest and for a very long time no volcanic eruptions have devastated the fauna, so we could therefore expect on Durian a rich and fairly normal fauna in comparison with its area. As the fauna of Krakatau before the eruption of 1883 is unknown, we must estimate by comparison what this fauna has been before and what it may be in future.

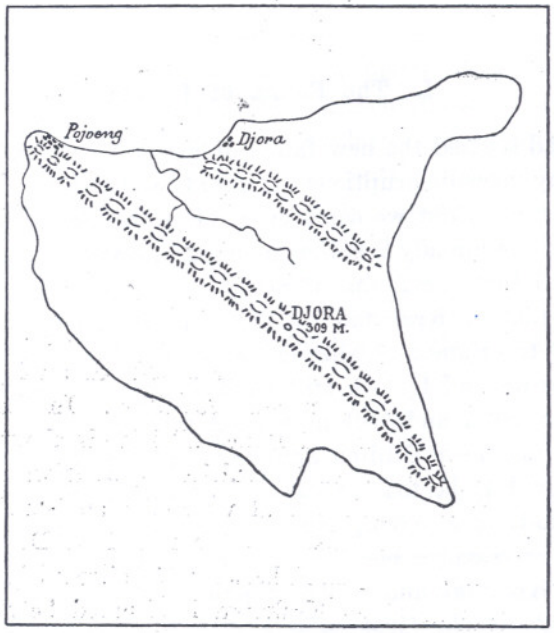
Before comparing the fauna's of the two islands it is necessary first to say something about Durian itself and its fauna.

Geographical.

Durian, more properly Great Durian, also named Moro besar, is one of the smaller islands of the Rhio-Lingga Archipelago (See Map on p. 296). It is situated on the eastern side of Durian Straits, which is a channel much frequented by vessels running from Singapore to Banca and Java.

For vessels proceeding from the south it is an important landmark, clearly visible from a long distance owing to its height (Peak of Durian or Jora, 309 M.).

The area is 1955 H.A., whereas Krakatau is 1392 H.A., but Krakatau is much higher, its peak reaching a height of 813 M. From a faunistical point of view Durian is much better situated than Krakatau, the distance from Singapore being 60 K.M., from Sumatra 35 K.M. A continuous chain of islands, however, is connecting the Malay Peninsula with the East-Sumatra coast.



Map of Durian; 1 : 100.000.

On the 11th June 1923 we arrived with the research-vessel "Brak" at the island. The day before we had sailed along the southern part of it and observed that the island does not consist of a single peak as we deduced from the sea-chart, but of several parallel chains of hills, some rising to a height only a little less than that of the heighest peak.

All the hills are clad with original jungle, only the small patches which were cleared in former years having now relapsed into secondary forest. As we were told later on, the land was cleared by Chinese during the great war in order to grow gambir, but as the prices of this product rapidly went down after the war the cultivations were abandoned.

The coast ia partly fringed by mangroves, but this kind of forest is of some extent only along the creeks which penetrate sometimes for a long distance into the island.

On the North coast where we went ashore we found a few beaches of white sand always forming a very small strip lined with a few cocoanuts. On some of these beaches there were remains of former habitations but now the whole population of the island is located in two small kampongs, one at the north-

View on the Peak of Jora, from the North. Foto P. Franck.

western end, called Poyung (Pojoeng — see Map) and the older one opposite Penyu (Penjoe) on the island Sugi bawah, named Jora (Djora).

On a low hill near the last-named settlement we found a suitable place to pitch our tents, the only drawback being that the shore consisted of black mud and became dry for a great distance at ebb tide. The small hamlet of Jora consists of three houses altogether; formerly more people appear to have lived there but have moved to the newer and better situated kampong Poyung.

The inhabitants of the island are very poor making their humble livelihood by cutting bakau-bakau wood (Rhizophora). The men cut the wood, which is sawed to a special measure, the women and children beating off the bark. This bark, which is very valuable for tanning, is thrown away and heaps and heaps of it lie rotting near the houses. The wood is purchased by Chinese merchants and exported to Singapore. Sometimes the population is also fishing but the fish is mostly comsumed at home, a small part being brought to Penyu on Sugi bawah where there is a fish-market. These "Orang Laut", who for the greater part of the day live in their boats, never feel inclined for agriculture; no cultivations whatever were found. Except the cocoanuts along the beach, mostly badly damaged by the rhinoceros beetle, and a few banana and papaw trees near their houses, no crop was grown.

The influence of this small population on the fauna must be extremely insignificant, as few or no animals could have been imported by them, their traffic being very unimportant, and no foodcrops having been introduced. In this respect also the island is fairly well comparable with Krakatau.

Our camp on the above-mentioned hill was well situated; the view we had over the wide sea with its numerous islands was spendid and every night we enjoyed the beautiful sunsets. The place was airy and we were not much annoyed by mosquitos, but numerous flies caused trouble.

Quite behind our camp was a fairly open area with single trees but largely overgrown with ferns *(Gleichenia)*. These trees for the greater part are a kind of Jack-fruit *(Artocarpus)*; the stems of which were loaded with rather small unedible fruits, much sought after, however, by the many monkeys on the island. All these open patches now overgrown by ferns or secundary forest are most probably abandoned plantations of gambir, but there was nowhere any trace of cultivation left.

On the top of the hill at the foot of which our tents were pitched, the forest was far from luxuriant consisting of many small densely-grown trees with only a few taller ones. On one of our excursions we walked for several hours through this forest and although it became somewhat more jungle-like it was always very poor compared with the luxurious primeval forest at the same elevations found in Java or Sumatra. The bigger and taller trees were always isolated, the underwood composed of numerous small stems, at best as thick as an arm and often very densely grown and difficult to penetrate. As far as we could see very little timber has been felled as there were very few stools to observe.

We tried also to reach the highest peak of the island but we did not succeed. We followed the ridge behind the kampong Jora in an easterly direction but as this ridge ran parallel with the main chain of hills, of which the peak of Jora is the summit, we always remained separated from the other hills by a very steep and broad valley. When we tried to cross this valley, we found it very broad and marshy, even the mangrove penetrating as far inland as here. There were many brooks and stagnant pools and swampy meadows, a good place in which to collect but hard to get through. At many places also the descent to this valley caused a great deal of trouble as we had to cut our way through an entangled mass of ferns and *Lycopodium*, the steep hill-side being, moreover, stifling hot as there were hardly any trees. In addition the ferns proved to be crowded with numerous very small ticks which readily attach themselves to the skin and were, notwithstanding their smallness, a great annoyance.

In this big valley a winding creek, bordered by Rhizophora, was running which we could follow at high water tide in a small boat for a long distance. In the end we could not go any further in the boat and walking was quite impossible, the ground being still muddy and overgrown with mangrove. But a smaller affluent creek led to dry land at the foot of some hills and we found a path there leading to a patch of cleared forest and going up the mountains.

In November 1923, when we came again to the island, we crossed the hills behind the village Poyung and found conditions quite the same as those near kampong Jora. We arrived at a big creek and a mangrove forest but here a path at the foot of the hills was leading to the end of the creek and there was a small grove of cocoanuts which had been formerly laid out by a Chinese but was now apparently abandoned, as his rather big house was a mass of ruins.

It seems that the whole island is intersected by deep and marshy valleys, the sea penetrating into these by long creeks where the water is always under tidal influence. The parallel chains of hills are all running in nearly the same direction, N. W. to S. E.

I brought home specimens of rocks from the island, which all proved to be old sandstones, in all probability of the mesozoic period. Samples of soil were also brought to Buitenzorg and were examined at the Laboratory of Soils here. Mr. WHITE, Head of this Laboratory, told me that this laterite soil was of an extremely poor senile nature.

Altogether we stayed at Durian from the 11th till the 18th June and from the 10th till the 18th November 1923. The first time Mr. P. FRANCK, our taxidermist was my companion; the second trip was made in the company of Mr. SIEBERS, the ornithologist of our Museum.

Fauna.

Previous to our visit Durian seemed never to have been collected on by any naturalist with the exception of Dr. ABBOTT of the United States National Museum, who throughly explored the whole Rhio-Lingga Archipelago during

1899 till 1903. Of this expedition a few mammals only are mentioned by MILLER for the island Durian.

The fauna of Durian, which was hoped to be a rich and varied one, proved somewhat disappointing and the locality did not yield what we expected. The very poor soil and in consequence of it the rather scanty vegetation is, I surmise, mainly responsable for it, fruit-bearing trees being almost absent. So we have not detected any fig tree on the island, which is one of the most attractive kind of trees for birds, insects and other animals.

In discussing the different groups of animals we may revert again to this poorness of the fauna.

Mammalia. (see List).

Altogether we found 12 species of mammals, half of the number being bats.

Monkeys are very numerous but they all belong to one species, the common "kra"; the existence of any other species which often occur on the bigger islands of this Archipelago, being denied by the natives here.

Further, three species or subspecies of rats, a wild pig and the Flying Lemur make up all the terrestrial mammals.

Squirrels, so widely distributed throughout the Rhio-Lingga Archipelago, and mouse deer, present on nearly all the other islands, are wholly missing and also the inhabitants told us that they had never met with them.

MILLER has recorded a few more rats *(Mus lingensis* and *Mus firmus)* and another species of wild pig from Durian which we failed to collect.

Aves (see List).

The Avifauna of Durian is far more interesting and richer than the mammalian fauna. No less than 56 species were recorded or collected. A common bird on the island is the beo or "burong tiung", as the Malay people call it. The note of this bird is heard every where but they are not often seen.

Doves are poorly represented; it may be that the abundance of monkeys is responsible for this as these quadrupeds are real marauders of young birds and bird eggs.

We have to call attention to a peculiar fact which struck us when visiting the island the second time. It proved that several species of birds common in June were never, or seldom, observed in November. So of the racket-tailed drongo *(Dissemurus paradiseus)* seen or heard every day and everywhere in June, only a few came into sight in November. Other birds exhibiting the same pecularity were the bettet *(Palaeornis longicauda)* and the hornbill *(Anthracoceros convexus)*. In June they were observed daily in numbers but in November they were not al all common.

Also the woodpecker *Thriponax javensis* was recorded in June only. The same curious seasonal difference was noticed among butterflies and moths. As the climate of the island is equal throughout the year, there being no special rainy season neither a dry monsoon, and we could not detect any remarkable difference in the vegetation in the mid or the end of the year, this

differentation of at least some groups of the fauna must remain unexplained for the moment.

Reptiles.

Reptiles were not so numerous as we expected; altogether 15 species were recorded. In addition to the species given in the list of Reptiles from the Rhio-Lingga Archipelago we observed a sixth snake in a mangrove tree; it was shot but disappeared in the current. Once a *Varanus* was seen in the forest at an elevation of 150 M.; the *Mabuia* in the neighbourhood of our camp was far from common. The turtle was collected in the swampy depression behind the kampong Jora.

Amphibia.

At the same place just mentioned frogs were living; we heard them every night but owing to the fact that in daytime they were not visible and the place being rather unpassable, we failed to get any. In November a number of tadpoles were collected in the well near our camp and other stagnant pools.

Pisces.

A species of *Dermogenys* and of *Betta* was observed in the brooks of the big valley behind the settlement where we had our tents. The *Betta* was also collected in a small mountain stream at about an elevation of 70 M. *Panchax panchax* we got from brackish water.

Insecta.

Insects were well represented, the total number being about 738 species. As the material has not yet been worked out we can only briefly review the different groups.

Hymenoptera. Altogether 84 species of Hymenoptera have been found, among which there are about 40 species of ants. The number of Hymenoptera parasitica is small and no more than 10 species could be collected. Fig insects were not met with as we could not detect any Ficus trees.

Of Coleoptera 152 species were recorded. *Cicindelidae* are well represented (5 species) but of aquatic beetles only one species was found. Surface Coleoptera are not abundant for which, I think, the poorness of the soil is mainly responsible (see also next chapter). Coccinellids, of which 3 species only were caught, are rather scarce, no wonder in connection with the small number of coccids, whereas aphids were not found at all.

Lepidoptera. Quite a large number of butterflies and moths was obtained, the latter being far more numerous than the former, viz. 162 species against 36. As already mentioned when dealing with the avifauna, there was a remarkable difference between the lepidopterous fauna of June and that of November. In June about 140 species were collected, of which number only 29 were met with again in November. The same curious fact was noticed with the Coleoptera, as of the 94 species collected in June, 23 only were again obtained in November.

Of Diptera we collected 53 species. Mosquitos were not a great nuissance, at least not at our camp which was situated at some elevation but

the were more numerous in the swampy region behind the settlement Jora. More trouble was caused by the abundance of flies, some of which stung painfully. Dr. S. L. BRUG, Chief of the Central Medical Laboratory at Batavia, has been kind enough to determine the mosquitos; they are the following species: *Aedes butleri* THEOB. or *umbrosus* BRUG, *Aedes amesi* LUDL., *Megarhinus splendens* WIED.; *Taeniorhynchus glibini* TAYLOR., *Pardomyia aurantia* THEOB. and *Stegomyia albopicta* SKUSE, all Culicinae.

The Rhynchota of our collection reach the number of 109 species, of which 54 are Heteroptera, 50 Homoptera and 5 Coccids. Aphids have not been found at all. Of aquatic bugs about six species could be recorded.

Thysanoptera are fairly abundant; the 13 species provisionally determined by Dr. KARNY are listed hereafter.

He has also named the Orthoptera (see List), which group of insects is very richly represented on the island. Altogether 91 species have been collected, distributed between the different families as follows: — Forficulidae 3, Blattidae 17, Mantidae 10, Phasmidae 3, Acridiidae 14, Locustidae 20, Gryllacridae 2, Gryllidae 21 and Gryllotalpidae 1 species.

Odonata. Of dragonflies 8 species were observed; 6 belong to the Aeschninae, 2 to the Agrioninae.

Isoptera. This is another group of insects whose abundance on the island is noteworthy. Everywhere moulds of white ants arise from the ground, and nowhere did these annoying insects cause us so much trouble as on Durian. All the luggage and boxes in our camp were repeatedly damaged by these insects and we had to fight daily against them. In addition to the mould-building species, another one making the nest around twigs of trees was very common. A big black species, marching unprotected on the ground in daytime in long files, was also often seen.

The 14 species of Neuroptera collected on Durian belong to the families Ascalaphidae, Chrysopidae, Psocidae, Myrmeleonidae, Mantispidae and Hemerobiidae. The common and beautiful Ascalaphids were very noticeable insects on the beach near the kampong Jora and one of the first which caught our attention. The four Psocids are perhaps all new species after Dr. KARNY (see his List).

Aptera. Of this group only 5 species have been obtained, among which are a *Japyx* and some guests from termite nests.

Myriopoda.

The scantiness of Myriopods on the island struck us, only six species altogether being caught, and also the number of individuals was always low. The poorness of the soil so far as its fertility is concerned has possibly something to do therewith, but on other soils which cannot be said to be very rich, like those of dry and sandy coral islands, Myriopods, specially Diplopods, sometimes abound.

Arachnida.

Also Arachnids are not so well represented, the total number of species

coming to about 67. Of spiders 48, and of free-living mites 8 species were obtained. In the foregoing pages we have already mentioned the small ticks which were abundant in fern-clad places and sometimes caused great trouble.

Crustacea.

Of terrestrial crustaceans we could collect 4 species, all belonging to the family of woodlice. Moreover, one species of a fresh-water shrimp was caught.

Mollusca.

As all other invertebrates, except insects, molluscs are among the rarest animals met with on Durian. Big or striking species are wholly absent and we found only two small ground-dwelling species, a slug and a *Pythia*. The last one was rather common on the beach and is more or less semi-marine.

Vermes.

Even more remarkable was the absence of earthworms. In the poor laterite soil not a single earthworm was to be found; behind the settlement Jora, where the soil was enriched by refuse, was the only habitat where some earthworms could be detected.

On the whole the poorness of the soil and surface fauna on Durian is very striking and is remarkable in contrast with the abundance of white ants on the island. The latter, however, do not thrive on the soil itself, like earthworms, but make their nests in the ground only as they live on wood and decaying material.

List of Animals from Krakatau, Sebesy and Durian (1).

	Krakatau.	Sebesy.	Durian.
Mammalia	3	4	15
Chiroptera.	2	2	6
Muridae	1	2	5
Aves	34	42	56
Resident birds	26	31	44
Reptilia	5	7	15
Lacertilia	4	4	7
Chelonia	0	0	1
Crocodilia	0	0	1
Ophidia.	1	3	6
Amphibia.	0	0	2 (?)
Pisces (freshwater)	0	0	2
Insecta	444	452	738
Hymenoptera.	80	62	84
Hym. parasitica	20	3	10
Formicidae	37	30	41

(1) Gall-producing species of which galls only were collected are not included in this list. This list is not always according to the previous one in Treubia III, 1922 as different groups have been worked out since.

	Krakatau.	Sebesy.	Durian.
Coleoptera	115	95	152
Cicindelidae	0	6	5
Col. aquatica	2	0	1
Lepidoptera	84	108	198
Rhopalocera	27	35	36
Heterocera	57	73	162
Diptera	46	40	53
Rhynchota	71	77	109
Heteroptera	37	42	54
Homoptera	28	30	50
Aphidae	1	1	0
Coccidae	5	4	5
Thysanoptera	10	9	13
Orthoptera	27	52	91
Forficulidae	1	5	3
Blattidae	6	7	17
Mantidae	1	1	10
Phasmidae	0	1	3
Acridiidae	7	15	14
Locustidae	7	11	22
Gryllidae	5	12	22
Odonata	4	5	8
Neuroptera	3	0	14
Isoptera	2	3	11
Aptera	2	1	5
Myriopoda	6	9	6
Diplopoda	3	5	3
Chilopoda	3	3	3
Arachnida	56	61	67
Scorpionidae	0	2	3
Araneae	45	48	48
Acari	6	4	8
Crustacea	3	5	5
Terrestrial	3	4	4
Fresh-water	0	1	1
Mollusca	6	15	4
Terrestrial	6	13	4
Fresh-water	0	2	0
Vermes	7	6	2
Oligochaeta	3	2	2
Total	564	601	912

II. Comparison with the fauna of Krakatau.

Our research of the fauna of Durian was wholly planned for the purpose of comparing this fauna with that of Krakatau, to see what Krakatau's fauna possibly was before the eruption and what it can be in future.

Now if we look at the above list we can see at a glance what the differences between the two faunas are. Taking the whole fauna into consideration we find that the total number of animals on Krakatau is about 62% of that of Durian, Sebesy being only a little richer, having 66%. But

with regard to the different groups of animals we find quite other figures. If we compare the vertebrate fauna of the two islands we see that in this respect Krakatau is still more behind Durian, the percentage being 41%, whereas Sebesy reaches already a figure as high as 59%. Considering only the terrestrial vertebrates, thus excluding bats and birds, we get far lower figures, viz., for Krakatau 21% and for Sebesy 32%. Now coming to the invertebrates, except insects, the result is quite unexpected. Here the poorness of Durian's fauna is clearly demonstrated as Krakatau has 93% and Sebesy even 114% of the number of invertebrates of Durian. Of insects only, Durian has a great majority, having about 40% more than Krakatau or Sebesy.

The remarkable conclusion of our comparison is that Krakatau has regained about 60% of its normal fauna after a lapse of less than forty years, if we could consider Durian's fauna as a normal one for a tropical island of such an extent. Now Durian certainly has a very poor fauna but nevertheless the foregoing conclusion may hold good for insects, bats and birds, which can without much trouble accomplish the distance separating Krakatau from other islands or the mainland. That the fauna of Krakatau even in this respect will be as rich after 70 or 80 years as before is certainly wrong as the increase of the fauna is not in direct proportion to the time. This increase follows undoubtedly a curved line, being more rapid in the beginning and slower in the end. We cannot say anything about the nature of this line before we have made further research and obtained some more data for interpolation. But, anyhow, one conclusion may safely be arrived at, the fauna of Krakatau will be complete not after centuries but within a comparatively short time, much shorter than we had ourselves excepted. The fauna of Krakatau will perhaps not become so rich as before but il will surely be much richter than that of Durian, its highly fertile soil and luxuriant vegetation being most favourable for attracting a rich and varied fauna. This richness of Krakatau's fauna is also proved by its soil and surface fauna as compared with that of Durian. From the list on p. 291 we can deduce an average for Durian of 19.3 species and 23.7 individuals on one square Meter, whereas on Krakatau we have found 20.4 species and on Sebesy 20.5 species on 1 M². so far as virgin forest is considered (See Treubia Vol. III. p. 79). For the same kind of forest the number of inviduals on 1 M². on Krakatau is even 68.4, three times that of Durian. The latter result demonstrated what we already mentioned in our previous paper (l.c.) that on Krakatau individuals are far more numerous than normally, but the above-mentioned figures show that the number of species on one square Meter is even higher than on Durian. Durian's soil and surface fauna is a poor one, an average of 30—40 species on 1 M². being normal for tropical lowland-forest (see Treubia Vol. VI p. 108). Krakatau has also already reached 50—60% of the normal with regard to this special kind of fauna.

Letting drop these general speculations, we may now briefly discuss the different groups of animals represented on Durian and on Krakatau.

Nos.	1		2		3		4		5		6		7	
Kind of Vegetation.	Second. Forest		Second. Forest		Second. Forest		Virgin Forest		Virgin Forest		Virgin Forest		Virgin Forest	
Altitude	0 M.		0 M.		0 M.		50 M.		50 M.		70 M.		175 M.	
Month	June		June		Nov.		June		Nov.		Nov.		June	
Layer of leaves and mould (in cM.)	5 cM.		4 cM.		2 cM.		4.5 cM.		3 cM.		3 cM.		3.5 cM.	
Number and species on 1 M².	n.	s.	n.	s.	n.	s.	n.	s.	n.	s.	n.	s.	n.	s.
Hymenoptera		3		4		5		7		4	2	2		2
Formicidae		3		4		5		7		4	2	2		2
Coleoptera			28	10			2	2	4	3	6	4	1	1
Carabidae			3	2			1	1						
Staphylinidae			23	6					4	3				
Pselaphidae													1	1
Tenebrionidae											1	1		
Curculionidae											1	1		
Diptera (larvae)			2	2							1	1		
Rhynchota					1	1			1	1				
Heteroptera					1	1			1	1				
Lepidoptera (larvae)														
Orthoptera	2	2	5	3	1	1			7	3	4	3	4	2
Blattidae	1	1	1	1	1	1			4	2	3	2		
Forficulidae			4	2					3	1			4	2
Isoptera				1		1				1				1
Aptera			1	1									2	2
Crustacea	3	1	6	2			2	1	5	2	2	1	1	1
Oniscoida	3	1	6	2			2	1	5	2	2	1	1	1
Amphipoda														
Myriopoda	1	1	1	1	1	1			1	1	1	1	1	1
Chilopoda					1	1							1	1
Diplopoda	1	1	1	1					1	1	1	1		
Arachnoidea	3	3	11	9	5	5	9	8	16	9	8	6	9	5
Araneae	2	2	6	4	3	3	5	5	11	7	1	1	3	2
Acari	1	1	3	3	2	2					3	3	5	2
Mollusca			3	2	3	1								
Vermes														
Total	9	10	57	85	11	15	13	18	34	24	24	18	18	15

Mammalia. Excluding bats, of which certainly many more species will reach Krakatau in future years, we find 9 terrestrial mammals on Durian against only one on Krakatau. This species, the common Malay house rat (*Rattus rattus diardi* JENT.) was introduced, as we presume, on the island about 1917 (see Treubia III p. 65). When we again paid a short visit to Krakatau, in July 1924, we set several traps at the place where formerly this rat was rather abundant but we failed to catch any. We also found at the same time two well-grown Pythons but without any remains of rats in the stomach. I presume the houserat has already disappeared from Krakatau in the few years since Mr. HANDL left the island (1921) or at least it is now on

the verge of extinction. This conclusion is in accordance with the theory that house rats are unable to live in the field, being so closely connected with man and human dwellings that if the latter disappear they are unable to maintain themselves. This fact has been brought to light by OTTEN, V. D. MEER MOHR and myself, and also some other investigators who have studied the rat problem in connection with plague in Java. But as such a small island as Durian harbours no less than five species of rats we may safely assume, I believe, that rats have a good chance of arriving at Krakatau another time, either by drifting wood or by human agency, and then the field rat is one of the first to be expected on the island.

Of the other mammals found on Durian the common Malay macaque (*Macaca irus* CUV.) may come to Krakatau in the same way but the chances are undoubtedly far less numerous. This macaque is the most wide-spread monkey of the Archipelago, going eastward as far as Timor, and I think this species is one that may readily get from island to island by trees floating in the sea or unintentionally through man. Everywhere this species is kept in captivity and is often seen aboard ships. Probably specimens becoming a nuisance or getting malicious may many times have been released on one of the islands.

What is said above about the macaque may hold good also for the common species of wild hogs of the Archipelago; moreover these animals are quite able to accomplish the rather short distances which separate Krakatau from Sebesy and Sebesy from the Sumatran mainland. It certainly will not be a great wonder to find a wild pig on Krakatau one day. The last terrestrial mammal of Durian we have to take into consideration is the Flying Lemur, but there is very slight chance that this peculiar and not very agile species may arrive by sea from one island to another. It requires special habitat and food and therefore it is not able to stand such unfavourable conditions as the omnivorous rats, pigs and monkeys.

A v e s. Of birds we may expect many more species on Krakatau in future, especially if the still abnormal vegetation improves and more fruitbearing trees arrive on the island. Seeing that such a poor island as Durian has nearly twice as many resident birds as Krakatau, we may safely draw the conclusion that the ornis of Krakatau will become twice as rich as it is nowadays.

On Durian there are no birds which could not have reached the island on the wing, but fresh water being absent on Krakatau such birds as are specially dependent thereon will not establish themselves on this island even if by chance they arrive at it.

We may here perhaps call attention to a recent publication by HOBBS (1). The author announces on p. 158 a most bold theory to explain the presence on Krakatau of a heavy bird native to Sumatra which cannot fly for any distance. He says that it is quite possible that this bird has been transported

(1) W. H. HOBBS, Cruises along Byways of the Pacific, Boston 1923.

from Sumatra to the island by a kind of circulating wind during the eruption. "The uprushes of gaseous and vaporous materials bring about a powerful indraft of air along the ground on all sides toward the crater, and in the case of Vesuvius sufficient to give falling projectiles as they approach the ground a direction t o w a r d the crater".

By this air current the heavy bird could have been sucked to Krakatau and along with it seeds and other vegetable matter for nourishment!

But the author does not explain how such a bird, even if it arrived alive on the island in such a wonderful way, could stand being buried by a layer of hot ash and pumice of many Meters thickness. Furthermore HOBBS does not mention the name of this heavy bird but Mr. JACOBSON of Fort de Kock, the well-known naturalist, informed me that the Crow-Pheasant (*Centropus javanicus*) is meant. If this is true, then HOBBS' theory is quite superfluous as *Centropus,* though one may call it a heavy bird, is quite capable of flying even for long distances, as are all other birds now found on Krakatau.

R e p t i l e s. The number of Lacertilia on Durian is not very high and all the species occurring there may easily arrive at Krakatau some day. Recently we were able to ascertain how quickly some species of skinks are spread. When we visited Krakatau in July 1924 I found, much to my surprise, *Lygosoma atrocostatum* on the island and not only a few specimens but the species has already become fairly numerous. In 1921 the species was certainly not there as we had our tents in exactly the same place and we did not notice any trace of this lizard then. This widespread Lygosoma was recorded formerly from Verlaten Island but even there it must have been a later importation as it was probably not present on that island in 1908.

Another reptile not observed on the Krakatau Islands in 1921 was the crocrodile and we thought its absence due to the lack of proper food and there being no rivers on the islands. Now in July 1924 for the first time we met with a crocodile on Verlaten Island. The beast, of 2.80 M. length, was detected lying in the brackish pool near the lake on the northern point of the island. It was so lazy and apathetic that we could get hold of it by passing a sling around its head. Its stomach was nearly empty, containing nothing but sand and mud and quite a number of nails which, I suppose, are those of a Varanus.

That purely fresh-water or land turtles may have a chance to come to Krakatau is not very probable, brackish-water species having a better opportunity on Verlaten Island where there are a brackish-lake and brackish pools.

The same may be said of Batrachians and fresh-water fishes; there is little or no chance of their arriving on the Krakatau Islands, their settlement on Krakatau itself, where fresh water is wholly absent, being impossible except for tree-frogs.

I n s e c t s. The insect fauna of Durian is far richer than that of Krakatau for, as already mentioned, the total number goes about 40% higher. As to Hymenoptera there is not such a striking difference between the two

islands; on both ants make up about half the number of all hymenopterous insects. Nearly all these Hymenoptera have great power of flight and I guess they were among the first invaders of Krakatau.

The total number of Hymenoptera for Krakatau given in the list on p. 288 does not agree with that formerly recorded (Treubia III p. 96) owing to the greater number of ants now known from Krakatau. After this group has been worked out (see WHEELER, this Journal Vol. V. p. 239) it proves that the number of species collected by myself goes to 29, to which we have to add eight more species found in 1908 by JACOBSON but not detected again by the author.

It seems that those Hymenoptera which are most easily spread from island to island have already reached Krakatau and the increase of this group in future will be only a slow one.

Of Coleoptera, however, we may surely surmise that they are still far from their maximum. Many beetles do not take so quickly to the wing as bees and wasps and their arrival on Krakatau is far more a matter of chance. In some respects Krakatau is in advance of Durian, specially the surface fauna on the latter island being poorly represented. Of surface-Coleoptera we have recorded for Krakatau 48 species; on Durian we could detect only half that number, a total of 23. For this difference the Staphylinidae and Tenebrionidae mainly are responsible.

The same as has been said above about Coleoptera may be maintained for the Lepidoptera on Krakatau; in this group also the total number will go up much higher than now. But here too the remarkable fact is observed that the best fliers have already arrived on the island, there being a small difference only between the number of butterflies found on Krakatau and that of Durian, whereas moths on the last-mentioned island are about three times as numerous.

Referring to the Diptera, we see that Durian doet not leave Krakatau so far behind it as in other groups of insects. Now I do not think we may safely draw the conclusion from this fact that flies too are among the first invaders of new land. The swiftiest fliers among the Diptera are mostly of the predaceous and parasitic habit, and not always finding their proper food and hosts on arriving, their settlement may go on only slowly. Whether the dipterous fauna of Durian is perhaps exceptionnally poor is a question which cannot be settled before we have examined what other islands show in this respect.

Of other groups of insects we call special attention to the very high number of Orthoptera recorded from Durian, more than three times those on Krakatau. This proportion of one to three is found again in many famlilies of this Order of insects but the number of the Acridiidae on Krakatau is only half that of Durian; Gryllids and specially Mantids being far better represented on the latter island. I suggest the small number of the last-mentioned group of Orthoptera on Krakatau has also something to do with the carnivorous

habits of the Preying Mantises, all predaceous and parasitic animals becoming less easily established on the island than scavengers and plant-feeders. The cause of the richness of Orthoptera on Durian is not clear but this island, otherwise so poor faunistically, may offer specially favourable conditions to this group of insects. The same may be true as regards white ants; the sterile sandy soil of Durian seems to be very attractive for the ground-burrowing termites.

That Neuroptera (s.l.) are up till now still scanty on Krakatau may be due to the same general rule discussed above; nearly all Neuropterous insects, except Psocids, being predaceous.

Invertebrates. We have already called attention to the remarkable poorness of Durian with respect to invertebrate animals, if we exclude insects. In one group, the Molluscs, Krakatau is even ahead of Durian, just a group which has the least chances of dispersal.

For another group, however, the spiders, we have to make an exception. Durian is not poor in Araneae but on Krakatau they are unusually abundant. The force of the theory that on new land carnivorous animals are later invaders than those feeding on plants or vegetable material, being so clearly illustrated by the absence on Krakatau of insectivorous bats and other carnivorous mammals, Cicindelidae, predaceous flies and the rareness of other groups of raptorial insects such as Mantids and Neuroptera, seems to be negatived by this richness of spiders on Krakatau. This exception of the rule may be explained by the extraordinary ease with which spiders are spread and by the fact that they live on flying insects, just the kind of animals which were the first newcomers to the islands. From the very beginning they were on the spot together with their proper food. One should say that this is also the proper food for insectivorous bats which are still missing on Krakatau but these bats, if they come to Krakatau, will come by their own initiative and are not blown to the island in immense numbers as young spiders are.

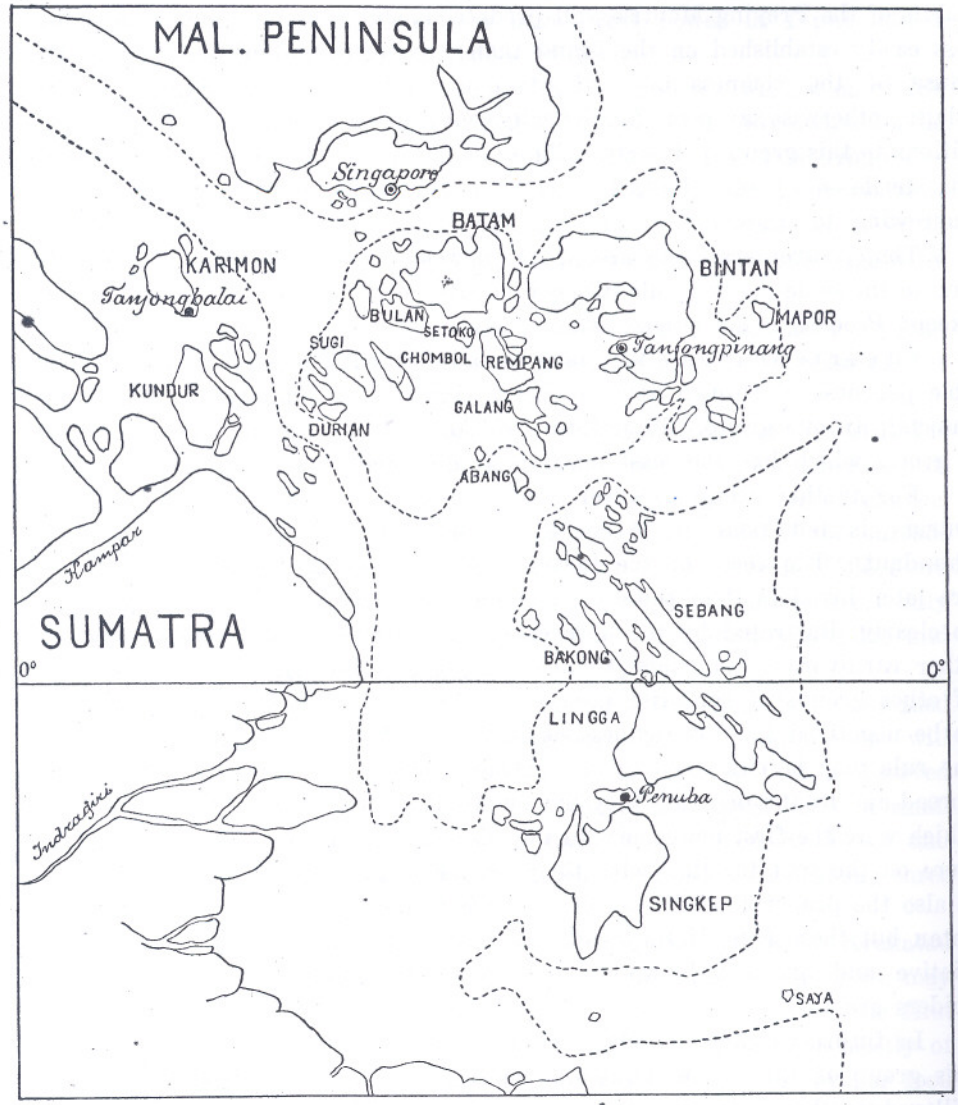
In future we may expect, I believe, rather a decline than an increase of this group of animals on Krakatau, more and more enemies arriving, which will reduce this group to normal proportions.

The higher number of Vermes on Krakatau is caused by the four species of worms belonging to the moss fauna. Samples of moss have been brought home from Durian too but their microfauna has not yet been worked out.

III. The Fauna of the Rhio-Lingga Archipelago.

When we were studying the fauna of Durian it became necessary to take also into consideration what was known faunistically of the other islands belonging to the Rhio-Lingga Archipelago. I think it will be useful for future studies to set down here the results of our investigations.

A few words about the geography of this Archipelago may not be out of place here.



Map of the Rhio-Lingga Archipelago; 1 : 2.500.000.
Dotted line Isobathe of 20 Meter.

Geographical (1).

The Rhio-Lingga Archipelago (Dutch: Riau- or Riouw-Lingga) lying between the southern end of the Malay Peninsula, Banka and Sumatra, does not belong geographically to the latter-named island but forms the continuation of the mountain chains of the Malay Peninsula.

(1) A recent topographical map of this Archipelago does not exist, the best information one gets is from the Dutch Sea chart (No. 103, Dec. 1918).

These rocky islands, some of which are rising to a considerable height, like the Peak of Lingga (1206 M.), are in remarkable contrast to the low and swampy coast of Eastern Sumatra. The exact number of the islands is not known. The Malay people say „banyaknja sagantang lada'': — as many peppercorns as there are in a gantang (about a gallon); and there are at least several hundreds. All these bigger and smaller islands can be arranged in three main groups lying on shallow banks, the boundaries of which are indicated by the 20 M. line (see Map) and separated from each other by much deeper channels. The first group consists of the islands Karimon and Kundur with some adjacent smaller islets but exclusive of the low islands at the mouth of the Kampar River. This group is separated from Sumatra by shallow water only but as these islands are rocky and mountainous they do not belong to Sumatra, the east coast of which consists of low and muddy land. The second and largest group contains Batam and Bintang and an innumerable number of other islands. The Singapore Straits run north; from the first-mentioned group these islands are separated by the Durian Straits and to the South the Pangelap Straits form an outlet for the waters of the big Indragiri river. The third group is the Lingga Archipelago, whereas the two first-named groups together form the Rhio Archipelago. The Lingga Archipelago consists of the two bigger and higher islands of Lingga and Singkep, the latter island being known for its richness of tin. The group is connected with Sumatra by a shallow bank but to the south a deeper channel is running from Saya in a westerly direction.

On the larger islands of the Rhio-Lingga Archipelago the original jungle has disappeared for the most part, the timber having been cut for export to Singapore. The cleared land has been occupied by the natives to some extent, and Chinese are growing pepper and gambir, but these cultivations are declining now. As the soil is poor and conditions are not favourable there are few, if any, European estates.

Historical.

One of the first papers on the fauna of the Rhio-Lingga Archipelago is by de Bruyn Kops (1854), consisting merely of a list of animals known from this Archipelago and neighbouring regions. The list is arranged after the Malay names of the animals; for many birds and mammals the author gives also the Latin names but in many instances these are evidently wrong.

As no exact localities are given, nor the boundaries of the area considered indicated, the list is almost worthless and has not the least authority.

Of much greater interest are the papers by Bleeker (1851—1868), who has recorded and described many Reptiles and fishes collected in the Archipelago by members of the "Kon. Natuurkundige Vereeniging".

After Bleeker little or no attention was paid to the fauna of these

islands for many years. SCHOT alone, in his excellent survey of Batam (1882), devotes a special chapter to the fauna of this island, and as he has given not only vernacular and Latin names but also short descriptions, it is possible to trace almost all the animals he takes into consideration.

After another twenty years Dr. W. L. ABBOTT (between 1899 and 1903) explored the Rhio-Lingga Archipelago for the U. S. National Museum. His extensive series of mammals and birds have been worked out by MILLER, LYON, ELLIOT and OBERHOLSER. The two first-mentioned authors have also described the mammals collected by BODEN KLOSS on Batam in 1905 and 1906.

Shortly after him, during 1908, ROBINSON of the Kuala Lumpur Museum made large collections in the Rhio Archipelago, and since that time it is almost exclusively the Museums of Kuala Lumpur and Singapore which take interest in the fauna of these islands.

Fauna.

The Fauna of the Rhio-Lingga Archipelago is but poorly known, except for mammals and birds. Reptiles and fishes have been studied to a small extent only, but the insect fauna and other invertebrates are almost quite unknown.

Mammalia (see List).

No less than 125 different forms of mammals have been recorded from this Archipelago but, as has already been pointed out by THOMAS and others, the many "species" described by American mammalogists should for the greater part be considered as subspecies, and even this rank may be doubtful in many instances. Of these 125 forms 57 may be reckoned true species and 68 subspecies. Of the 57 species two only are peculiar to the Archipelago, viz., *Sciuropterus amoenus* MILL. and *Crocidura maporensis* ROB. et KLOSS. At least 45 species are common to Sumatra and the Malay Peninsula; 6 species are found in the last-named country but not in Sumatra, all six belong remarkably enough to the Chiroptera. On the other hand this island has 3 species in common with the Archipelago which are missing in the Peninsula, viz.: — *Sus vittatus* MÜLL. et SCHL., *Nannosciurus melanotis* MÜLL. et SCHL. and *Tupaia tana* RAFFL.

Of the subspecies no less than 54 are confined to these islands; this high number is no matter of surprise if we consider that many authors take a fancy to make new subspecies for every new locality.

With regard to the mammalian fauna, all the larger islands, and many of the smaller ones, have been fairly well explored and in this respect the fauna of the Archipelago does not show any great differences. Of the species not present in the Malay Peninsula *Nannosciurus melanotis* and *Tupaia tana* seem to occur only in the Lingga Archipelago; on the other hand the six bats which are missing in Sumatra are confined to the northern groups of islands.

Aves (see List).

Altogether we know at present 127 species of birds from Rhio-Lingga, none of which is peculiar to this Archipelago. The majority occur both in Sumatra and on the mainland; three only are known from the Malay Peninsula and not from Sumatra, viz., *Stachyris davisoni* SHARPE, *Chelidon dasypus* BP. and *Plegadis falcinellus* L. But the absence in Sumatra of at least the two latter species is doubtful as they are found in Java and elsewhere. *Caprimulgus affinis* HORSF. is the only bird on these islands which is recorded from Sumatra and absent in the Malay Peninsula.

Of the 13 subspecies found in this Archipelago three only are peculiar and all of these have been described by OBERHOLSER.

There are certainly many more birds to be found in the Rhio-Lingga Archipelago as the avifauna of only a small number of islands is known. Many more islands have been explored but the collections made by Dr. ABBOTT have not yet been worked out fully and there is no report on the results of the expedition of ROBINSON in 1908 as far as birds are concerned. It is only mentioned that they are "of no particular interest" which means probably that no new species or subspecies were collected.

Reptilia (see List).

As many as 42 species of Reptiles are listed from these islands: — 15 Lacertilia, 3 Chelonia, 1 Crocodile and 23 Ophidia. None is peculiar, nearly alle are to be found in Sumatra and the Malay Peninsula. One tree-gecko, *Gymnodactylus consobrinus* PTRS., a Sumatran and Bornean species, is not recorded from the mainland. On the other hand *Lygosoma atrocostatum* LESS., a species spread from Penang to the New Hebrides, has not yet been collected in Sumatra, although the author has recorded it from Verlaten I. near Krakatau.

With the exception of the islands Bintan, Batam, Durian and Singkep, the reptiles of no other islands have been studied.

Amphibia (see List).

Three species only of Batrachians are mentioned for this Archipelago by VAN KAMPEN, two belonging to the genus *Bufo* and one to *Rana*. *Bufo gymnauchen* BLKR., recorded from Bintan, does not occur in the Malay Peninsula, neither in Sumatra, but is found in Borneo and the Nicobars; it seems to be a rare species.

Fresh-water Fishes (see List).

Twenty-two species of fishes living in fresh water are recorded from these islands. For the greater part they have been studied by BLEEKER but many of his papers deal exclusively with marine species. Thirteen species only can be considered as true fresh-water fishes, the others living also in brackish water or in the sea.

Nearly all occur both in Sumatra and in the Malay Peninsula. One species only, *Puntius lawak* BLKR., is not found on the mainland.

Insecta.

Our knowledge of the insect fauna of the Rhio-Lingga Archipelago is so scanty that we cannot say anything about it. Dr. KARNY who has kindly looked up for me how many Orthoptera have been recorded from this Archipelago, told me that altogether two Phasmids only, *Diesbachia tamyris* WESTW. and *Calvisia rufescens* REDT., are mentioned as occurring in the Lingga Archipelago.

Without doubt a number of Lepidoptera and beetles have been described from these islands but as no lists nor special papers exist dealing with the insect fauna of one of these islands, it is quite impossible to go over the whole literature to find out what is known in this respect.

Mollusca.

With reference to the land- and fresh-water shells we can only repeat what we have said about the insects, but in this case Miss VAN BENTHEM JUTTING of the Amsterdam Museum has been kind enough to inform me which species are known from these islands. They are: — *Cyclophorus aquila* SOW., *Nanina striata* GRAY and *Amphidromus aureus* var. *melanomma* PFR. (v. MARTENS, Ost-Asiatische Landschnecken 1867, p. 135, 229 and 340). A few more semi-marine *(Auricula)* and marine species have been recorded but these few are all that are known at present.

Concerning the other invertebrates, it seems that the collections from Durian are the only ones of any extent ever made in this Archipelago.

Zoogeography.

Although our knowledge of the fauna of the Rhio-Lingga Archipelago is still very imperfect, some conclusions about the zoogeographical position of these islands may be drawn.

With regard to the vertebrate fauna, this Archipelago is throughly homogenous with Sumatra and the Malay Peninsula. It has no peculiar species; the two mammals confined to it are perhaps no exception to this rule as they are newly described and may in future be referred as subspecies to a species already known.

Furthermore the affinities are in no way obviously more with the Sumatran than with the Malay Peninsula fauna. A few bats seem to have come down from the mainland to the northern part only of the Archipelago whereas to the Lingga group of islands are confined a few species known from Sumatra: — two mammals and the gecko, *Gymnodactylus consobrinus*.

The American authors, specially MILLER, have dwelt on the remarkable fact that the mammals of this Archipelago, where such uniform environmental conditions exist, show such a great specific differentiation. Now the whole question depends on the appreciation of their "species". These species upon which these authors theorize are no species at all but at best subspecies, and in many instances the characters used for specific distinction are so variable

that it is hardly possible to recognize their different island forms. If there are geographical races in this Archipelago the differentiation is not so much the result of different local conditions but more of isolation. On bigger islands and on larger land masses, the units of which a species is built up become intermingled, but on smaller islands one or another of these units may become isolated or predominating.

It is almost certain that the Rhio-Lingga Archipelago at the end of the Pliocene period was brought into close connexion with the Malay Peninsula and Sumatra and even with Borneo. Later this large land mass became divided by submergence, or raising of the sea-level, into innumerable bigger and smaller islands and the species units became isolated and separated from each other, so that intermingling was not possible any more. At least this applies specially to the mammals, as the barriers for their distribution are far more effective than for birds and reptiles.

But there is another remarkable fact exhibited by this Archipelago. If geologists are right these islands have not been submerged after the mesozoic period as tertiary strata are wholly absent. Furthermore these islands have not been devastated by volcanic action which so powerfully, especially during the tertiary period, decimated organic life on many of the East-Indian Archipelago islands.

As the result of such a lengthy period of undisturbedness one would anticipate the presence of many old forms on the islands of the Rhio-Lingga Archipelago, but nothing of this kind has been detected, at least so far as the vertebrates are concerned. It seems that the invasion of the modern fauna coming from the Asiatic mainland has completely swept away the older fauna without leaving any trace of it. Moreover just the oldness of the region has resulted in a very poor soil as for an immense period it has not been enriched by fresh deposists, and on this poor soil a luxuriant vegetation cannot grow. These unfavourable conditions, as well as the smallness of the islands, may have been fatal to the preservation of the older forms, being mostly the weaker ones as compared with more modern species.

But higher animals become more easily replaced by allied species than lower ones, and it may be that amongst the molluscs or other invertebrates of this Archipelago we will find a reminiscence of older periods.

List of the Mammals from Durian.

(the species with an * have been identified by C. BODEN KLOSS).

1. Macaca irus F. CUV.

♂ 241, June 1923; total length 1020, tail 590, ear 35 mm.

♀ 242, juv. June 1923; total length 633, tail 375, ear 27 mm.

The Malay macaque, better known as *Macacus cynomolgus,* was very abundant on Durian and the only monkey on the island. A host of species of this common monkey has been described by ELLIOT but their rank even as subspecies may be in many instances doubtful, the forms being based on individual variation only.

The species from the Rhio-Lingga Archipelago are separated by the colour of the hands mainly, but the differences in colour used by ELLIOT in his key (in Review of the Primates) are practically imperceptible, it being nearly impossible to identify a certain form by it.

The specimens from Durian come nearest to *bintangensis* ELLIOT, from Bintan and Batam, but in the male the colour of the back is a little more rufous and the upper part of the tail not black but darker gray, speckled with ochraceous. The young female has the same colour as the male, the back being only of a less brighter hue.

The tooth rows are straight but in the male the upper incisors seem to be heavier as in *bintangensis.*

2. Sus spec.

Wild pigs were very common on Durian and were met with several times but we did not succeed in getting any.

Two species have been recorded from Durian viz., *S. vittatus* and *S. barbatus.*

* **3. Rattus rajah pellax** (MILLER).

♀ 542, Nov. 1923; total length 410, tail 193, ear 20 mm. Mammae 2—2 = 8.

Only one specimen of this subspecies of *R. rajah* was obtained; it is the first record of the species from the Rhio-Archipelago.

Mr. BODEN KLOSS wrote me that it is the Peninsular race, not the Sumatran form (*R. r. similis* ROBN. & KL.).

We have of this species in our Museum only the type of *R. rajah hidongis* KLOSS (Treubia II, 1921); the specimen was formerly preserved in spirit so the original colour of the pelage has perhaps changed a little. The only difference in colouring between *hidongis* and the specimen from Durian is that in the latter form the white srtipe on the inner sides of the hind limbs is much narrower than in *hidongis.* The differences in the skulls as pointed out by BODEN KLOSS are but very slight.

4. Rattus rattus neglectus JENT.

♂ 235, 239, June 1923.

♀ 234, 236, 237, 240, June 1923; ♀ 541, Nov. 1923.

This is the common field rat of the Indo Australian Archipelago, spread from the Malay Peninsula to New Guinea.

Although this subspecies has always been named *neglectus* I do not think JENTINK's name is rightly applicable to this form. As far as I remember and from my notes taken in the Leiden Museum of the type, its belly is not yellowish as described by JENTINK but more pale grayish brown and much too dark for a field rat.

The question, however, of this subspecies being identical or not with JENTINK's *neglectus* must be postponed until it is possible to compare this form with the type of *neglectus*.

In colour of the underparts, this subspecies does not show such a great variation as the house rat and mostly it is readily distinguished from the following form by its lighter belly and shorter tail. But sometimes we meet with individuals, especially if the differentation between field and town is not yet very pronounced, which are difficult to allocate. So on Durian we found two specimens of *rattus* (No. 538 and 539) which, with some hesitation, I bring to the following subspecies. It is difficult to tell what they are: — house rats in the making or perhaps cross-breedings between the two subspecies.

5. Rattus rattus diardi JENT.

♂ 539, Nov. 1923.

♀ 537, 538, 540, Nov. 1923.

The house rat was not so common on Durian as the field rat. Three of the four specimens were trapped quite in the neighbourhood of the native dwellings but, as already mentioned, the people would not allow us to set traps in their houses.

Underneath the specimens are pale gray, the nos. 538 and 539 more grayish white.

6. Galeopterus variegatus IS. GEOFFR.

♀ 238, juv., June 1923; total length 400, tail 160, ear 18 mm.

♀ 551, Nov. 1923; „ „ 595, „ 222, „ 21 mm. Mammae $2 - 0 = 4$.

The Flying Lemur *(Galeopithecus volans)* seems to occur fairly abundantly on Durian, as on the other islands of the Rhio-Lingga Archipelago. Another female with young was found in the stomach of a Python caught in the mangrove by the natives.

The female shot in November is an adult as it was bearing a fullgrown embryo. Its upper pelage is of a fine silvery gray hue, the patagium between fore- and hind-limbs darker gray with undulating black stripes and speckled with white. The young female of June is less gray, more tawny.

The Flying Lemur of the Rhio-Archipelago has been described as a separate subspecies (*aoris* MILL.) on account of its smaller size and very small teeth. Specimens from Java are indeed much bigger, have a much darker pelage and the teeth much larger, specially the molars.

7. Pteropus vampyrus L.

Flying Foxes were seen several times in the evening but at daylight we could not detect any. Probably they only visit the island coming from one of the larger islands or from the mainland. In June when we were at anchor in the Amphitrite Bay (mouth of Indragiri river) nearly every night we saw large flocks flying from the Sumatra coast in the direction of the island of Singkep, a distance of at least 50 K.M.

* **8. Cynopterus brachyotis** S. MÜLL.

♂ 548; ♀ 549; and four alcoholic specimens; Nov. 1923.

These bats were hanging in clusters under the leaves of cocoanut palms near kampong Pojoeng (Poyung).

* **9. Balionycteris maculata seimundi** KLOSS.

♀ 545, Nov. 1923; total length 61, expanse of wings 276, ear 10, forearm 41 mm. Mammae 1 — 0 = 2.

♀ 546, and two young ones in spirit; Nov. 1923.

Of this very interesting species two females, each with a young one, were found on a tree between dried leaves.

This most conspicuous fruit-bat with well-defined yellowish white spots on the membranes and head was first only known from Borneo.

Recently Mr. BODEN KLOSS has discovered the species in the Malay Peninsula and has described it as a new subspecies: — *seimundi* (Journ. F. M. S. Museums Vol. X. 1921, p. 229). It differs from the true *maculata* by the less developed postorbital processes, which are short and obtuse instead of pointed and elongated. He says: — "We may reasonably expect to meet someday with *Dyacopterus* in the Peninsula and *Balionycteris* in Sumatra". The find of the species in the Rhio Archipelago brings the distribution already nearer to Sumatra.

10. Cheiromeles torquatus HORSF. (?)

In November every night we observed a high-flying bat with long pointed wings. As it was flying very quickly and turning round like a swift it was impossible to obtain a specimen. In the air it continually makes a peculiar crackling noise.

Mr. BODEN KLOSS told me that it was probably the above-named species which is very common in Singapore and in the Rhio-Archipelago.

* **11. Kerivoula hardwicki** (HORSF.) (?)

♀ 543, Nov. 1923; head and body 40, tail 42, expanse of wings 260, ear 14, forearm 34 mm.

♀ 544, with young (♂) in spirit; Nov. 1923.

The specimens were taken in the jungle living between dried leaves.

12. Rhinolophus trifoliatus TEMM.

♂ 547, Nov. 1923; alcoholic specimen.

One night when it was almost dark one specimen was obtained by net while several came to catch termites emerging from their mounds.