ON JALORENSIS-RATS AND OTHER MAMMALS FROM THE KRAKATAU ISLANDS.

By

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On the mammals discovered on the Krakatau Islands after the eruption of 1883 only some scattered notes have been published hitherto, but no comprehensive report has appeared.

No mammals were collected by JACOBSON in 1908 but as he did not use traps, he could not tell whether they were really absent. He mentioned, however, that during the three nights he stayed on the main island not a single bat was to be seen.

In my opinion mammals had not yet arrived on the islands at the time of JACOBSON's visit (except perhaps the rats on Lang Island), as the first species detected later on (1919) were bats (*Cynopterus brachyotis*) which were represented already both on Krakatau and Verlaten Island.

From our first arrival when we started our researches we often disturbed bats when strolling through the forest and they were frequently seen roosting in shrubs or low trees, so it seems probable that they arrived on the spot between 1908 and 1919.

The next year (1920) a second species of the same genus (*C. horsfieldi*) was detected on Krakatau itself but was not found until ten years later on Verlaten Island. This species seems to be less common and, at least on Verlaten I., a later introduction.

The first insectivorous bat was collected in 1928, a single specimen only of *Hipposideros diadema,* at an altitude of 600 m.

As late as 1933 a fourth species of bat (*Rousettus amplexicaudatus*) was discovered in a cave on the East coast of Lang Island. On the same island also a *Cynopterus* occurs as we saw (October 1933) at twilight a specimen, holding a fig-fruit in its jaws, dodging along the path running to the sea.

In addition to bats the islands are inhabited by rats. One species, the common house-rat (*Rattus r. diardi*), occurring on the main island of Krakatau, has certainly been introduced by human agency. When a certain Mr. HANDL settled on the island in 1917 they were not yet there, but soon after, in 1919, they were already a familiar sight and even a nuisance.

In 1924, when Mr. HANDL had left the island and his house had fallen into ruins, they seemed to have disappeared altogether as we were not able to catch

any although we set several traps each night of our sojourn. As the same time the large *Python* was found to be fairly numerous so we ventured to attribute the vanishing of the rats to the presence of these snakes or to their inability to hold their own when their usual habitat was no more.

This assumption, however, proved to be untenable as in January 1933 and the following year the species was again abundant and apparently had recovered from the blow received some ten years ago.

Another rat, also belonging to the *rattus*-group (*R. r. jalorensis*), the wide-spread Malay country-rat, was met with on Lang Island. It was already there and even plentiful in 1928 at the time the observation-post of the Volcanological Survey settled on the island, so it was certainly not introduced by this party.

Whether or at what time it has been imported by fishing-boats or arrived on the island by some other means must be left undecided. The supposition of the animal having survived the disaster of 1883 is hard to believe. Even if the species was not entirely exterminated by the eruption it could not possibly hold its own afterwards on an island covered with a layer of hot ashes of several metres thickness and destitute of all vegetation and nutriment. This species of rat is easily introduced as it is found even on the smallest islands and especially those which are uninhabited.

Other mammals besides bats and rats, have not yet been found, but in December 1933, when landing on the S.E. coast of Krakatau at a spot where fishermen sometimes pass a night on the island and have dug a well, we saw near the beach a small black dog, skinny and shy, which hurried off as soon as it got wind of us. Much to our surprise we found in April 1934, disembarking at the same spot, the fresh prints of a dog on the sands and in the evening the same black dog was seen roving about the shed of our coolies.

This noteworthy fact in the first place proves that pet animals are sometimes released or having run away are left behind by the owner, and in the second place that even domesticated animals can live a semi-wild life for several months on an uninhabited island like Krakatau.

This time it was a dog but next time it may be a monkey that is set at liberty, the common gray macaque being not rarely kept as a pet by fishermen.

In this connection we would call attention to an observation made by HICKSON, told in his book "A Naturalist in North Celebes" (1889, p. 190): — "Some days after the eruption of Krakatau in 1883 a female green monkey was found floating on some drifting timber in the Sunda Straits. She was terribly scorched, but completely recovered, and is, I believe, still alive". How long this green monkey (apparently the common macaque) remained "still alive" is not known but anyhow another female monkey may some day be drifted towards Krakatau in the same way and if it is a pregnant female we may be welcomed on landing on the island in the future by the chattering shrieks of macaques bounding in the trees along the beach.

Rattus rattus jalorensis BONH.

Mus jalorensis

BONHOTE, Fasc. Mal., Zoöl. I 1903, p. 28.

Rattus rattus neglectus

ROBINSON & KLOSS, J.F.M.S. Mus. VIII 2, 1918, p. 54 [1]).

Mus rattus rufescens

OTTEN, Med. B.G.D. 1924, p. 132, 164. VAN HEURN, Korte Med. Inst. Plantenz. 9, 1928.

Mus rattus jalorensis

DAMMERMAN, Treubia X 1928, p. 308. IDEM, Krakatau's New Fauna, 4th Pac. Sc. Congress, 1929 p. 90. IDEM, Agric. Zool. 1929, p. 280.

Rattus rattus roquei

SODY, N.T.N.I. 89, 1929, p. 163. IDEM, Z.M.L. 13, 1930 p. 94, 120. VAN HEURN, Z.M.L. 13, 1930, p. 151. KOPSTEIN, Med. D.V.G. I 1931, p. 42. IDEM, Z. Morph. Oekol. der Tiere 22, 1931, p. 792.

Rattus rattus alexandrinus rufescens

DE RAADT, Z.M.L. 14, 1931 p. 43, 187, 190; 16, 1933, p. 31.

Rattus rattus jalorensis

CHASEN, Bull. Raffles Mus. 8, 1933, p. 6.

Mus sp.; *Epimys* sp.

DAMMERMAN, Med. Lab. Plantenz. 24, 1916, p. 4. IDEM, Landb. Dierk. 1919, p. 222.

On Lang Island, the island of the Krakatau group which is not set apart as a nature-reserve, we found in 1928 abundantly a long-tailed rat with a pure white belly. The upper parts are glossy and of a dark grizzled tawny colour, the hairs interspersed with many slender flexible spines. The lower part of these spines is white but they become darker along the outsides towards the upper part, which is entirely blackish. Fur of the back otherwise composed of long black hairs each with a broad yellow-brown ring towards the end, the tip dark again; underfur of grey woolly hairs. The colour on the sides and the upper side of hind and forelimbs more greyish.

Young specimens are darker in colour and less spiny.

Under parts pure white, the white colour extending as far as the lower lips, the forepaws and feet, and in the male on the underside of the scrotum, the latter often with a rusty patch. In one example such a patch was found also on the breast. Line of demarcation between the colour of the upper and lower parts sharp. Fur consisting of white spinous hairs and white crinkled woolly hairs.

Feet above whitish, with a dark greyish brown median area.

Tail longer than head and body (107 - 131%, average 115%), entirely dark, clothed with dark stiff hairs which do not extend as far as the end of the scales of the following ring. Number of rings to the centimetre at the middle of the tail about 11.

Mammae 10: two pectoral and three inguinal pairs.

The penis-bone or baculum is a peculiarly shaped bone (see fig. 1), composed of two probably movable pieces, the posterior piece slender with a broadened base, the anterior part spatulate, flattened vertically. Total length 7,5 mm.

[1]) For the abbreviations see Treubia 13, 1931, p. 430.

For measurements see tables p. 432 & 434.

This rat was already extremely common on Lang Island when for the first time in 1928 the Vulcanological Survey made an observation-post on the island, so the species was not introduced by this party. Before that date the island had neither been inhabited nor even visited for any length of time. It cannot be supposed that any rats survived the catastrophe of 1883 by hiding in some underground burrow, as the whole island was covered by a thick layer of hot ashes and pumice-stone. This layer remained hot for several weeks so the rats could hardly escape destruction. Even if they did they would not be able to find any food for a long period, as the whole of the vegetation was destroyed and even the animal life in the sea in the neighbourhood of the islands was annihilated. It is practically certain, therefore, that the species arrived at the island either through a pregnant female being drifted to the shore on some floating log or other object, or it was introduced unintentionally by some fishing-boat.

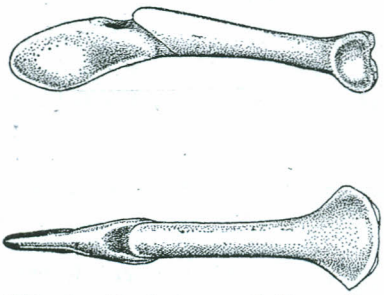

Fig. 1. Penis-bone of *R. rattus jalorensis*, side-view and dorsal view; 7 ×.

Every time we visited the island this rat was extremely abundant and at night an annoyance in the sheds built by the Geological Survey and the Marine Wireless Station. On one occasion, in February 1928, using only five traps, we caught no less than 49 specimens in one night. The rats do not appear to live in holes, we opened all kinds of holes but never found a rat, most of the holes being inhabited by large crabs which are formidable opponents and certainly able to keep the rats outside, even if unprotected by their burrows these crabs are a match for the rats. In daytime we never saw these rats in the low trees and shrubs covering the island, only once an old abandoned nest composed of dry leaves and small twigs was detected in a tree, which according to our native collectors was a rat's nest. On another occasion I saw a female carrying a naked young one in its mouth, running along the bamboo joints of our pondok, where it was probably nesting in the roof-thatching.

On Lang Island this rat is certainly not a true tree-rat, high trees being still absent on the island, it is far more accustomed to a terrestrial life, as at night many were always observed on the ground in search of food in and around our dwellings.

Lang Island II, 1928, 4 ♂♂, 2 ♀♀; XI 1932, 1 ♂, 2 ♀♀; I 1933, 1 ♂, 1 ♀.

We identified this rat with *Rattus rattus jalorensis*, BONH. "the Malay country-rat" [1]), originally described from the Malay Peninsula. For comparison we were able to examine good series of this form from the original locality, Sumatra and Java. We are indebted to the Director of the Raffles Museum at Singapore for the loan of the material of these rats from the said localities.

[1]) We prefer to call this rat "country-rat" to avoid confusion as the name "field-rat" (veldrat) is often used for the specialized form occurring in the rice-fields.

R. rattus jalorensis from the Malay Peninsula.

The specimens kindly lent by the Raffles Museum came chiefly from Perak and Kuala Lumpur, but there was practically no fresh material, most specimens having been caught between 1906 and 1910.

The colour of the upper parts therefore is a little faded and less glossy than in our series from Lang Island, but otherwise the colour and also the composition of the fur is the same. The colour of the underside is more creamy white and often soiled, this certainly also owing to the material being not so fresh.

The total length of these rats averages less than in the Lang Island specimens, but this is mainly due to the tail being shorter; head and body are on the average 168 mm, max. 175 mm, whereas the tail has a medium length of 180 mm and max. 193 mm (see table p. 431). Also the hindfoot (mean length 31,8 mm, max. 33 mm) seems to be a little shorter.

As to the skull there is a great similarity both in shape and in measurements between those of the Peninsular rat and of the Lang Island form (see table). The mean total length as well as the other measurements of the skull exactly match those of the Lang Island examples, the maximum length being 43.6 mm is only a trifle more than the maximum length of 43.2 mm measured in a specimen from Lang Island.

Regarding the habitat the labels of the Raffles Museum specimens tell us that some of these rats were trapped in the jungle, others near houses, and one was found in a hollow mangrove tree with the nest and three young, the nest composed of mangrove leaves and small sticks. Of the original series from which *jalorensis* was described 5 specimens came from deep jungle, the other 3 being caught in rice-fields.

If we compare the above data with those from the original description (by BONHOTE 1903) we find the following differences: the average measurements (in mm, those of the type in brackets) given for the head and body are 145 (144), tail 165 (177), hindfoot 30 (31.5); greatest length of skull 38.5 (40), basilar length 31.7 (32). All these measurements fall short of those resulting from the series at our disposal, but this may be the outcome of chance in collecting.

Recently CHASEN (1933) has published a more detailed description of the *jalorensis*-rats occurring in the Malay Peninsula. Their ranges come much nearer to those compiled above than those of the original description. We borrow for comparison the following figures from his paper, averages and maxima (in brackets): — head and body 165.6 (176), tail 173 (198), hindfoot 31.4 (35), ear 19.8 (22), percentage of tail to head and body 104.5 (115); skull occipito-nasal length 40.9 (44.3).

On the whole the Lang Island form agrees fairly well with the typical *jalorensis* from the mainland of the Malay Peninsula, the somewhat longer tail and larger feet do not justify subspecific distinction, there being too much variation in these characters. Moreover this primitive rat is liable to a great deal of variation as to its habitat and the length both of the tail and the

hindfeet seems to correspond to various modes of life. In some instances, however, as in the Java sawah-rat (the race of the irrigated rice-fields) these variable characters owing to adaptation to a very exclusive habitat during a prolonged period, become more stable and give rise to a very constant and different race.

R. rattus jalorensis from Sumatra.

We were able to examine only a small series of country-rats from Korinchi in Central Sumatra collected by the Raffles Museum in 1914 at an elevation between 700 and 1400 m. From other localities in Central or South Sumatra we have no material at hand which can be referred with certainty to *jalorensis*.

Above the Korinchi rats are snuff brown, a little darker and more glossy than the typical *jalorensis* but the colour is influenced by the spines which are less numerous, this being always the case with forms found in higher altitudes. The fur is similar but longer, more woolly and more dense, as could be expected of rats living in mountain regions. One example shows two rather large whitish patches, one on the left shoulder, the other behind the right shoulder.

Pelage of the under parts white but out of the series of 11 specimens 4 show a dark median grey line which is more conspicious on the middle of the breast. In one example this greyish suffusion spreads over nearly the whole underside except on the throat and the innerside of the limbs. Probably this specimen is a transitional form approaching one of the semi-parasitic forms.

Feet above also somewhat darker.

As to the length of head and body, tail and hindfoot this mountain form comes very near the typical form from the mainland of the Malay Peninsula (see table p. 431).

The skull is on the average a little smaller, relatively shorter and broader, but this may be due to nearly half the number of specimens not being adult animals.

Although there are some differences between this mountain rat and the typical form these are certainly not of racial value. ROBINSON and KLOSS in their paper of 1918 called this rat *R. r. neglectus* [1]) and also stated after comparing the Korinchi series with a large number of *jalorensis* rats of the Malay Peninsula that no subspecific distinction is to be found amongst them.

Rattus rattus jalorensis from Java.

The Javanese country-rat (Mal. tikus ladang), formerly called *rufescens* (OTTEN, v. HEURN) is a well-known form, commonly referred to by the native name "tikus kuning" [2]) or "tikus pohon".

From Java we have before us a good series of this rat, material from West Java (Wijnkoopsbaai), Central Java (Karang Bolang) and East Java (Idjen) being kindly lent by the Raffles Museum.

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[1]) *R. r. neglectus*, however, is not a synonym of *jalorensis*, but of *diardi*, the house-rat.

[2]) The name "kuning" (yellow) was given on account of the yellowish underside of this rat.

The country-rats from West Java (loc. Wijnkoopsbaai and Buitenzorg) do not exhibit any essential differences from those from Lang Island, they present the same points of distinction from the typical *jalorensis* and those from Korinchi, having a larger hindfoot and a relatively longer tail.

The skull averages a trifle larger but otherwise in its proportions it is not different.

Of the Buitenzorg specimens one was trapped in a house and two caught in the Botanical Gardens. The weight of a full-grown animal is given as 122 grammes.

A good series of 12 specimens of this rat from Garoet, West Java, at an elevation of about 700 m, deserves special attention. We owe this series to the kindness of Mr. W. C. VAN HEURN who collected these rats between X and XII 1928 being at the time engaged with the economic side of the rat-problem.

The colour of the upper parts in these rats is perhaps somewhat lighter and the fur less spinous, the spines being less numerous and more slender. The underside is creamy white, sometimes washed with yellowish. This colour as well as the lighter hue of the upper pelage may be due to the specimens having been preserved in spirit. The tail is relatively longer, its percentage to head and body being on the average 123, ranging from 104 to 138 percent.

The body-weight is given as ranging from 115 - 147 grams, averaging 128 grams.

Four of the rats were caught in sugar-palms (Arenga), one in a coconut-palm, three came from salak-palms (Zalacca) and four again were found in Lantana-bushes.

Many of these rats are said to be parasitized by a cestode living subcutaneous, often also ascarides are found in the stomach and bladder-worms in the liver, different species of mites occurring as external parasites.

The series from Karang Bolang, Central Java (coll. Raffles Museum, II 1920) consists of 8 specimens. These agree fairly well with the other examples from W. Java and Lang Island averaging only slightly larger. Also the skull-length is on the average a trifle more. But these differences may be due to chance in collecting, especially if we have before us only small series and from a limited number of localities for comparison. Moreover, in maximum lengths they fall a little short of those from West Java.

The averages of a series of country-rats from East Java (all from the Idjen mountains between 500 and 950 m) are again a trifle less than those from Central or West Java, but otherwise they present no special points of distinction.

The Java country-rat has been made by SODY (1929) the type of a special form, *R. r. roquei.*

He separated this form from *jalorensis* on account of the larger skull, which according to him presents a maximum length of 45.5 mm as against 44.5 in *jalorensis* from the Malay Peninsula. SODY does not give the ranges of his series nor individual measurements except of his type-specimen, which having a skull-

length of 45.5 mm is obviously the largest example of his series. Furthermore his measurements are not quite exact as his figures are not in tenths of millimetres. Moreover, when comparing our figures we have to keep in mind that we measured the total skull-length (from the middle of the occipital crest to the anterior border of the premaxillae) whereas SODY gives the greatest length (including the nasalia).

From the measurements listed by us (table p. 436) we see, however, that the average skull-measurements of both forms agree exactly. We found the maximum total skull-length in examples from West Java to be 44.1 against 43.6 in *jalorensis* from the Malay Peninsula. But even if there does exist a difference in occipito-nasal length of 45.5 mm as against a maximum of 44,3 in Malay Peninsula examples (CHASEN 1933), the founding of a new subspecies on a difference of only 2 percent. in length in the largest examples is in my opinion an unwise procedure.

Further this author laid stress upon the greater length of head and body of his *roquei* compared with *jalorensis*. Our figures show that the Java specimens average somewhat larger than the Malay Peninsula form but it is mainly in the greater length of the tail and the hindfoot as already recorded also for the specimens from Lang Island.

VAN HEURN (1930) laid emphasis on the great differences in the life-history of the *roquei* of Java and *jalorensis* from the Malay Peninsula.

We will first refer to his interesting notes about *roquei*, which is called by him the Javanese tree-rat. According to him this rat lives chiefly in high trees, such as palms, but also in bushes, occasionally visiting houses or barns. In Java it is not a common rat and nowhere represented in large numbers. Its special habitat is lower and higher trees and it is seldom if ever found in holes. Nests are also made only in high palms or bamboo. Coconuts attacked by this rat show an irregular hole gnawed near the stalk of the fruit whereas the coconut-squirrel usually makes a round hole in the middle or near the top of the nut gnawing off first a considerable part of the husk. Its litter consists as a rule of 3 - 5 young. This rat in an able swimmer but it does not prefer inundated areas.

The author compares these results with the data communicated by WRAY in a paper on "the sugar-cane rat, *Mus jalorensis*" (Journ. F.M.S. Mus I, 1905, p. 39). This "sugar-cane rat" is extremely common in the Malay Peninsula and very destructive to rice-fields and other crops. It lives and nests in underground holes and the litters are much larger, sometimes as many as a dozen. If persued this rat escapes readily into the water. In all these respects this "sugar-cane rat" agrees exactly with the Java sawah-rat (*R. rattus brevicaudatus*).

Now in the first place our Java country-rat is not such an exclusively tree-loving animal as emphasized by VAN HEURN.

He bases his conclusions, I suppose, mainly on his observations made in

Garoet. But in other localities and especially on small islands untouched by human cultivation our rat readily descends to the ground and lives there in holes or in hollow trees and such recesses. Whether it is able to dig its own hole we have so far no proof.

Another point to notice is that there is a great deal of difference between the habitat afforded by the inundated rice-fields (sawah) of Java and the dry rice-fields such as are usually found in other less cultivated islands and also in the Malay Peninsula. VAN HEURN's statement that *jalorensis* was found by BONHOTE in "sawahs" is certainly erroneous. In his original description BONHOTE speaks of 3 specimens being caught in rice-fields (vide supra), but here without doubt are meant dry rice-fields, as his other examples came from deep jungle.

In the second place VAN HEURN says there can be no doubt that WRAY's notes refer to *jalorensis*, although this author himself speaks of the rat being "probably" *jalorensis*. From the recent paper by CHASEN (1933) we know now that the rice-field rat or sugar-cane rat of the Malay Peninsula is n o t *jalorensis*. This form is identified by him as *argentiventer* which comes very near to our Java sawah-rat or *brevicaudatus*. Whether these two forms are identical must be left undecided for the moment.

This examination of the facts reveals that when VAN HEURN contrasted the habits of the two rats from Java and the Malay Peninsula, he was referring to two different forms, so there is no need on these grounds to separate the Java *jalorensis* from the typical form.

It may be that the country-rat in Java is becoming more and more a semi-parasitic form owing to the vanishing of its original habitat in the low-lands and will be split in the long run entirely into a true digging and an arboreal form, the latter distinguished by the longer tail and somewhat brighter hue of the upper pelage.

If *jalorensis* can be a tree-rat as well as a burrowing rat we may look for characters by which these habits are to be discerned. DE RAADT (1913 & 1931) called attention to the differences in the pads or the hindfoot between the house-rat (*R. r. diardi*) and the rice-field rat (*R. r. brevicaudatus*). The first one being a climbing rat has these pads much more strongly developed than the digging rice-field rat.

The *rattus*-rats have 3 pairs of pads on the sole of the foot, two situated at the implantation of the three middle toes, one at the base of the large and another at the base of the little toe, and two behind these (see fig. 2). The four foremost pads are a little broader than the breadth of the toes, the two hindmost ones are a little narrower. On the forepaw there are 5 pads, one situated at the base of the two middle fingers, one pair behind this at the base of the exterior fingers, and two near the wrist, these two being much larger than the three others.

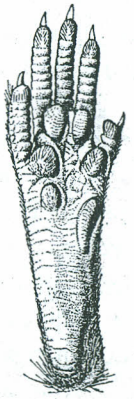

Fig. 2. Sole of hind-foot of *R. rattus diardi*; 1⅓ nat. size.

It is a fact that in the rice-field rat these pads are less developed and a little flatter and usually also smaller than in the house-rat. *Jalorensis* is usually somewhat intermediate between the two forms just mentioned. But there is much variation in development and by means of this character alone it is very difficult to make a correct identification. Moreover, this feature can only be made out in specimens still in the flesh or preserved in spirit, in dry skins it fails altogether.

Therefore we had to look for a more decisive character by which the burrowing and climbing habits could be distinguished and found such a character in the nails. The house-rat as a true climbing rat has curved, sharply pointed nails whereas the nails of the digging rice-field rat are stronger and larger, less sharpened and less curved being elongated and ending in a blunt point. In *jalorensis* we found the nails again somewhat intermediate: sometimes the nails are like those of *diardi*, other examples having them more like those of *brevicaudatus*. In the Lang Island specimens, however, the nails of the forpaw are very short and obtuse being nearly triangular in shape seen from the side (see fig. 3), but in a few examples they come nearer to those of the rice-field rat. Such very blunt and shortened nails obviously do not indicate a climbing habit but are built rather for digging and it may be that the very coarse material of which forms the soil on Lang Island, consisting mainly of a conglomeration of smaller and larger pumice-stones, has something to do with the rather peculiar shape of these nails.

Fig. 3. Nails of the middle fingers of *R. rattus*; a. *R. r. jalorensis* from Lang I.; b. *R. r. brevicaudatus*; c. *R. r. diardi*.

In extreme development the characteristic form of the nail may be a certain indication for the mode of life of the rats, in other cases it may help in identifying a certain form better than the development of the pads on the sole which character is not practicable in skins.

Another question is whether we should apply subspecific names to the above mentioned forms of *rattus* which are certainly only ecological races. Many authors make no distinction between true geographical races and so-called minor forms. True geographical races as a rule should exclude and replace each other whereas ecological or habitat-forms may be found side by side in the same geographical area. Now most taxonomists agree that subspecific names should be applied only to true geographical forms and that ecological or habitat forms do not deserve a trinominal nomenclature. On the other hand we need to denote them, as botanists often do with their "Standort-modifikationen", in some way or another, and we could indicate them by applying e.g. the name *"forma arvalis"* for the digging form of the geographical race *jalorensis*, *"forma arborea"* for its long-tailed arboreal form, *"forma montana"* for the soft-furned less spinous or spineless mountain form. All these names would of course have

no priority but could be applied separately to each subspecies which showed this parallel development of environmental forms.

This is a more convenient mode of distinction than the application of a quadrinominal nomenclature, which is somewhat excessive, the first method having, moreover, the advantage of indicating that we are dealing with other races than geographical ones and at the same time giving by the name an indication of the habitat or habit of the form under consideration.

There is, however, one difficulty. In some cases we may be in doubt to which subspecies a certain minor form should be referred. For instance it is not quite clear whether our house-rat (*diardi*) is really a descendant of the country-rat *jalorensis*. We find rarely intermediate forms but it is possible that these are hybrids between the two forms. Moreover, house-rats are easily dispersed by man and in many localities in our Archipelago they are certainly immigrants and not derived from indigenous forms. The question can only be settled by breeding or observations on introduced rats (vide infra).

In such doubtful cases it will be better not to distinguish the habitat forms by a trinominal nomenclature but, by using the word "forma" after the specific name, to indicate that we are not dealing with a subspecific form but with an ecological race.

Measurements

jalorensis from Malay Peninsula

	♂	♂	♂	♂	♀	♀	♀	♀	♀	♀
total length	354	357	362	357	350	343	339	332	344	337
head & body	175	172	169	166	170	170	167	165	164	159
tail	179	185	193	191	180	173	172	167	180	178
ear	20	20	21	21	—	22	22	20	—	20
hindfoot	32	32	33	32	31	33	33	30	32	30
tail-rings	11	13	11	9	11.5	12	10.5	11	11.5	11

jalorensis from Korinchi, C. Sumatra

	♂	♂	♂	♂	♂	♀	♀	♀	♀	♀
total length	378	344	342	336	335	371	359	348	328	312
head & body	187	164	162	158	157	184	170	165	155	149
tail	191	180	180	178	178	187	189	183	173	163
ear	20	17.5	20	18	19	21	18	19	19	19
hindfoot	35	32	33	34	31.5	33.5	32	31	32	31
tail-rings	11	11	13	10.5	10.5	10	12.5	11	11	12.5

jalorensis from Lang Island (Krakatau)

Btzg. Mus. No.	3396	1556	1557	1555	3398	1554	1552	3394	1553	3397
	♂	♂	♂	♂	♂	♂	♀	♀	♀	♀
total length	403	401	386	383	366	330	388	375	358	330
head & body	187	185	187	179	172	143	184	176	170	149
tail	216	216	199	204	194	187	204	199	188	181
ear	21	20.5	20	20	—	18	20	20	21	20
hindfoot	37.5	35.5	35	35	34	34	35	34	35	34
tail-rings	10.5	11	11	11.5	11	11	9.5	10	11.5	11

jalorensis from W. Java

Btzg. Mus. No.				3401	958	3399	129
	♂	♀	♀	♂	♀	♀	♀
total length	405	363	349	387	402	359	—
head & body	185	170	169	174	191	171	156
tail	220	193	180	213	211	188	—
ear	22	21.5	20.5	19	21	21	15
hindfoot	36.5	33.5	34	36	35	32	32
tail-rings	11	10	10	11.5	9	11	11

jalorensis from Garoet, W. Java

Btzg. Mus. No.	2128	2121	2117	2120	2124	2112	2125	2129	2126	2122
	♂	♂	♂	♂	♀	♀	♀	♀	♀	♀
total length	416	366	364	362	401	390	380	381	369	364
head & body	191	179	166	162	181	164	168	169	159	164
tail	225	187	198	200	220	226	212	212	210	200
ear	21	20	19.5	19	21.5	21.5	21	20	20	19.5
hindfoot	37	34	32	35	35	35	34	36	33	35
tail-rings	10	11.5	11	9	9.5	10	10	11	11	11

jalorensis from Karang Bolang, C. Java

	♂	♂	♂	♀	♀	♀	♀	♀
total length	403	392	376	405	395	386	390	375
head & body	187	182	176	188	183	176	176	172
tail	216	210	200	217	212	210	214	203
ear	20.5	20	20	21	22	21	21	21
hindfoot	35	37	34	35	35	35.5	36.5	34.5
tail-rings	11	10	10.5	10	11	10	9	11.5

jalorensis from Idjen Mts, E. Java

Btzg. Mus. No.				673	672	676	671
	♀	♀	♀	♂	♂	♀	♀
total length	355	353	346	366	358	389	394
head & body	165	158	151	169	175	185	190
tail	190	195	195	197	183	204	204
ear	19.5	20	20	20	20	20	21
hindfoot	33	33	33	33	31	35	34
tail-rings	10	11	11	10.5	10.5	9.5	9.5

Skull-measurements

jalorensis from Mal. Peninsula

	♂	♂	♂	♂	♀	♀	♀	♀	♀	♀
total length	39.7	40	43.6	42	41.8	39.1	41.2	39	42	41.1
basilar length	36.2	—	39.2	38.1	38.1	36.1	36.3	36.2	38.1	36.8
zygomatic breadth	18.8	18.8	20.5	20.5	20.7	19.1	19.9	19	19.4	19.5
least interorb. breadth	6	6	7	7	7	6	6.4	6.5	6.6	6
cranial width	15.2	15.4	16	15.7	15.8	15.7	15.8	15.9	15.8	15.9
length of a nasal	13.9	14.3	16	15.8	15.5	14.7	15	14.6	14.6	15
greatest br. comb. nasals	3.8	4.5	4.4	4.7	4.5	4.3	4.6	4.3	4.1	3.9
incisive foramina	8	8	8.4	8.3	8.2	7.8	8.2	8.2	8.6	8.2
length of diastema	11.4	11.2	12.5	12.4	11.9	11.1	12.3	11	12.1	11.9
length upper molar ser.	6.8	7.3	7.5	7.2	7	7.1	6.8	6.7	7	6.5
length lower molar ser.	6.4	7	7.1	6.5	6.6	6.7	6.7	6.6	6.6	6.1

jalorensis from Korinchi, C. Sumatra

	♂	♂	♂	♂	♂	♀	♀	♀	♀	♀
total length	40.8	38.3	39.6	38.1	38	40.2	40	38.4	39.4	37.9
basilar length	37.4	34.3	35.2	33.5	34.1	—	36.7	35.6	35.3	34.8
zygomatic breadth	19.3	17.3	19.3	—	18.3	20	19.8	18.8	19.3	18.7
least interorb. breadth	6	6.2	5.9	5.8	6.2	6.3	6.4	5.8	5.9	6.1
cranial width	15.5	13.7	15.8	15.7	15.6	15.6	15.7	15.2	15.4	15.5
length of a nasal	14.6	14.3	14.1	13.8	13.5	14.6	14.2	14.9	14.1	13.5
greatest br. comb. nasals	4.4	3.8	4	4.1	4.2	4	4.2	4.2	4.2	4.1
incisive foramina	8.1	7.7	7.9	7.4	7.1	7.6	8.1	7.5	8	7.2
length of diastema	11.7	11.1	11.4	10.6	10.8	11.6	11.5	11	11.1	10.6
length upper molar ser.	7	6.7	6.8	6.3	6.8	7	7.2	6.8	6.8	6.7
length lower molar ser.	7	6.3	6.5	6.1	6.4	6.5	6.9	6.4	6.3	6.4

jalorensis from Lang I. (Krakatau)

Btzg. Mus. No.	3396	1556	1557	1555	3398	1554	1552	3394	1553	3397
	♂	♂	♂	♂	♂	♂	♀	♀	♀	♀
total length	42.1	41	40.7	41.2	40.8	37.7	41.5	40.2	43.2	40.2
basilar length	38.8	37.3	37	37.7	37.3	33.9	38.5	36.2	39.3	36.7
zygomatic breadth	20	19.8	19.1	20.1	20.2	18.3	20.4	19.3	20	19.3
least interorb. breadth	6.7	6.5	6.3	6.4	6.6	—	6.2	6.2	6.9	6.2
cranial width	15.7	15	15.3	15.9	15.7	14.5	15.6	15.2	15.6	15.2
length of a nasal	15	14.8	14.8	14	15.3	13.7	15.6	14.3	16.2	13.7
greatest br. comb. nasals	4.3	4.2	4	4.7	4.4	4	4.4	4.2	4.6	3.6
incisive foramina	7.9	8.1	7,4	8	7.7	—	7.6	7.6	7.6	7.8
length of diastema	12.3	12.1	12	12.5	11.9	10.8	12.4	11.8	13.2	11.5
length upper molar ser.	7.2	7	6.8	6.7	7	6.8	7	6 5	7	6.7
length lower molar ser.	7.1	6 5	6.6	6.4	6.5	6 3	6.7	6.1	6.6	6.5

jalorensis from W. Java

Btzg. Mus. No.				3401	958	3399	129
	♂	♀	♀	♂	♀	♀	♀
total length	44.1	41.6	40.7	41.6	42.7	41.8	39.2
basilar length	40.5	37.6	37.5	38	39.6	38	36.8
zygomatic breadth	21.5	20.5	19.7	20.7	20.3	20.6	20.1
least interorb. breadth	7.2	6 6	6 4	6.3	6.8	6.3	6.2
cranial width	17.2	16.4	16.1	16.4	15.8	16.3	15.9
length of a nasal	17.3	16.5	15	15.6	16 2	14.6	14.4
greatest br. comb. nasals	4.9	4.7	4.4	4.5	4.8	4.5	4
incisive foramina	8	7.4	7.5	7.1	8.1	7.6	7.4
length of diastema	12.3	11.4	11.2	11.3	12.5	11.8	10.7
length upper molar ser.	7.8	7.1	7.8	7.7	6.9	7.2	7.8
length lower molar ser.	7.2	6.8	7.3	7.5	6 6	6.6	7.4

jalorensis from Garoet (W. Java)

Btzg. Mus. No.	2128	2121	2117	2120	2124	2112	2125	2129	2126	2122
	♂	♂	♂	♂	♀	♀	♀	♀	♀	♀
total length	41.3	40.1	38.6	40.8	42.3	41.6	40.7	40.4	38 4	38.5
basilar length	38.4	37	35.9	36.6	38.9	37.5	37.7	36 6	35.9	35
zygomatic breadth	19.7	20.4	19	20	21.5	20	21.2	20.4	19.2	19.4
least interorb. breadth	6.7	6.2	6.7	6.1	6.5	6.6	6.3	6	6.1	5.8
cranial width	16.3	15.9	15.4	15.7	16.3	15.8	15.5	15.8	15.2	15.6
length of a nasal	15.3	15.3	14.4	14.6	15.6	15.2	15.2	14.5	14.4	14
greatest br. comb. nasals	4.6	4.5	4.3	4	4.4	4.4	4.4	4.1	4.3	4.1
incisive foramina	7.8	7.6	7.2	7.4	8	7.4	7.9	7.6	7.8	6.6
length of diastema	11.8	11	11	11	12 3	11.4	11.4	11.2	11.1	10.3
length upper molar ser.	7.5	7.2	7	7.5	7.1	7 6	7.1	7.2	6.7	7.2
length lower molar ser.	6.9	6.9	6.9	7.3	7	7.5	7	7.2	6.5	7

jalorensis from Karang Bolang, C. Java

	♂	♂	♂	♀	♀	♀	♀	♀
total length	42.1	43.8	40.3	43.4	41.7	43	43.2	41.3
basilar length	38.4	40	37.5	40	38.7	38.6	40.6	38.4
zygomatic breadth	19.7	21.7	19.2	21.1	20.3	20.4	20.4	19.7
least interorb. breadth	6.7	6.6	6.3	6.5	6.9	7	6.8	6.2
cranial width	15.7	17.3	16.1	16.4	16.3	16.1	16.6	16.1
length of a nasal	15	16.4	15.1	16	15.5	15.8	15.7	14.9
greatest br. comb. nasals	4.8	4.8	4.2	4.5	4.8	5	4.8	4.3
incisive foramina	7.6	7.3	7.9	7.8	7.5	7.9	8	7.6
length of diastema	11	11.5	11.1	12.6	11.5	12	12.1	11.6
length upper molar ser.	7.3	7.6	7.1	7	7.4	7	7.2	6.6
length lower molar ser.	—	7	—	6.7	7.2	6.7	7	—

jalorensis from Idjen Mts, E. Java

Btzg. Mus. No.				673	672	676	671
	♀	♀	♀	♂	♂	♀	♀
total length	39	41.7	39.2	38.6	40.8	43.9	43.7
basilar length	35.3	38	34.4	35.4	38.3	40.5	40.2
zygomatic breadth	18.7	20.5	18.8	19	20.5	21.3	21.9
least interorb. breadth	5.9	6.6	6.3	6.2	6.6	7.2	7.2
cranial width	15.6	16.1	16	16.1	15.8	16.8	16.8
length of a nasal	13.4	15.2	13.9	13.2	13.9	16.3	16.1
greatest br. comb. nasals	4.3	4.4	4.2	4	3.9	4.8	4.6
incisive foramina	7.3	8	7	7	7.7	7.9	8.5
length of diastema	10.1	11.5	10	10	11.7	11.8	12
length upper molar ser.	7.8	7.4	7.3	7.3	6.8	7.7	7.7
length lower molar ser.	7.3	7	7.5	6.9	6.7	7.5	7

Average measurements of *R. r. jalorensis*

	Mal. Pen.	Korinchi	Lang I.	W. Java	Garoet	C. Java	E. Java
total length	347	345	372	378	379	390	366
head & body	168	165	173	174	170	180	170
tail	180	180	199	201	209	210	195
percent. tail to h. & b.	107	109	115	115	123	117	115
ear	20.8	19.1	20	20	20.3	20.8	20
hindfoot	31.8	32.5	34.9	34.1	34.6	35.3	33.1
tail-rings	11.1	11.3	10.8	10.5	10.4	10.4	10.3

Average skull-measurements of *R.r. jalorensis*

total length	41	39.1	40 9	41.7	40.3	42.3	41
basilar length	37.2	35.2	37.3	38.3	37	39	37.5
zygomatic breadth	19.6	19	19.7	20.5	20,1	20.3	20.1
least interorb. breadth	6.5	6.1	6.4	6.5	6.3	6.6	6.6
cranial width	15.7	15.4	15.4	16.3	15.8	16.3	16.2
length of a nasal	14.9	14.2	14.7	15.7	14.9	15.5	14.6
greatest br. comb. nasals	4.3	4.1	4.2	4.5	4.3	4.7	4.3
incisive foramina	8.2	7.7	7.7	7.6	7.5	7.7	7.6
length of diastema	11.8	11.1	12	11.6	11 3	11.7	11
length upper molar ser.	7	6.8	6.9	7.5	7.2	7.2	7.4
length lower molar ser.	6.6	6.5	6.5	7.1	7	6.9	7.1

Max. measurements of *R.r. jalorensis*

head & body	175	187	187	191	191	188	190
tail	193	191	216	220	226	217	204
hindfoot	33	35	37.5	36.5	37	37	35
total length of skull	43.6	40.8	43.2	44,1	42.3	43.8	43.9
length upper molar ser.	7.5	7.2	7.2	7.8	7.6	7.8	7.8

Rattus rattus diardi JENT.

DAMMERMAN, Treubia 3, 1922, p. 65. IDEM, Krakatau's New Fauna, 4th Pac. Science Congress, 1929, p. 93.

On the main island of the Krakatau group, Krakatau itself or Rakata, occurs the house-rat which was found there for the first time in 1919 on the south-eastern side of the island. In subsequent years material was collected at the same spot, but only once, in 1920, an example was trapped on the opposite side of the island, near "Zwarte Hoek". The colour of the lower parts of this specimen is dark mouse-gray, much darker than in examples from the S.E. corner. Otherwise the colour of upper and under surface of these rats is not different from ordinary house-rats and varies in the same way especially as to the ventral surface. These parts are light greyish to deep mouse-gray in colour, a few specimens with a tawny suffusion or a more or less distinct brownish median line. In the lightest example the gorget is white, there is a broad median stripe on the throat and the innerside of the forelimbs and the axils are whitish.

From the figures given in the table below, we may see also that the average measurements and their ranges do not show any essential differences from those of other house-rats. Only the number of tail-rings being on the average 12.5 seems a trifle higher than is usually the case.

On the feet the pads are strongly developed, the nails being formed as in house-rats generally but a few specimens have the nails more prolonged as in *brevicaudatus*.

In all females the number of mammae is 2 - 3 = 10.

The penis-bone has the same form as in *jalorensis*.

Measurements

R. r. diardi from Krakatau

Btzg. Mus. No.	2099	2100	3405	3406	3407	3408	3409	3410	3411	3412	aver.
	♀	♀	♀	♀	♀	♀	♂	♂	♂	♀	
total length	360	355	380	355	370	387	383	—	382	346	366
head & body	184	170	186	167	182	188	196	183	187	173	182
tail	176	185	194	168	188	199	187	—	195	173	185
ear	—	—	19	19	19.5	20	21	19.5	20	19	19.6
hindfoot	34	34	35	32	32	34	34.5	32	33 5	32.5	33.4
tail-rings	12	15	11	12	13	12 5	12	13	12	12.5	12.5

Skull-measurements

total length	43.1	40.8	42.7	40	41.5	42.8	44.6	41.5	42.7	40.7	42
basilar length	38.6	37	38.6	36.5	37.2	39.1	39.8	37.2	39.8	36.7	38
zygomatic breadth	20.4	18.6	20.3	18.5	19.1	20.2	20.6	19.3	19.4	19.7	19.6
least interorb. breadth	6.7	5.8	6.4	5.8	6	6.2	6.2	6.1	6	6	6.1
cranial width	16.4	15.7	16.5	15.3	15.4	15.9	16.4	16.1	16.2	15.8	16
length of a nasal	14.8	14.4	14 4	13.5	14.2	14.4	15.4	14.5	14.7	14.1	14.4
greatest br. comb. nasals	4.3	4	4.4	4	4 1	4.3	4 5	4	4.1	4	4.2
incisive foramina	8.7	8.1	8.6	8	8 2	8 4	8.5	8	8.8	8.1	8.3
length of diastema	12	11.3	11.5	10.7	11 6	12.2	12	11.1	11 5	11	11.5
length upper molar ser.	7.2	6.7	7.3	6.8	6.8	7.3	7 2	7.2	7.5	6.6	7.1
length lower molar ser.	6.4	6	6.6	6	6.2	6.4	6.6	6.5	6.6	6.5	6.4

House-rats are now fairly common on Krakatau Island and were certainly introduced by man. When a certain Mr. HANDL settled on the island at the S.E. corner in 1917 there were, according to him, no rats but soon afterwards he observed them in sufficient numbers to be a great nuisance.

In my paper of 1922 I supposed that the rat found at the N.W. corner of the island (near Zwarte Hoek) came from the other side of the island as it did not seem probable that house-rats would have been imported into Kra-

katau twice at two different places. But after that single capture of September 1920 we were never again able to trap a specimen at the said spot and as the only example caught there has a much darker ventral surface than any rat from the S.E. side of the island we may not exclude the possibility of a second import at Zwarte Hoek.

Every time we visited the island previous to July 1924 we were able to trap some specimens. On that occasion we did not succeed in getting any although we set large a number of traps, as usual, nor were they observed at our camp either in the daytime or at night. In a previous paper (Treubia 8, p. 291) I presumed this species of rat had already disappeared from Krakatau in the few years since Mr. HANDL left the island (1921) house-rats being apparently unable to maintain themselves if they are compelled to live independent of men. But as later on they were found again in numbers and as at the same time in 1924 we found a few full-grown pythons and a number of young ones, probably the increase at that time of these large rat-feeding snakes must be regarded as responsible for the temporary disappearance of the rats. In January 1933 they occurred again in fairly large numbers at the same spot, the pythons being then absent.

It is interesting to ascertain how these house-rats lived after Mr. HANDL's departure in 1921, when his house, built of wood and bamboo, fell into disrepair and after a few years was razed to the ground.

After that year the rats had to return to a wild life, to nest in natural abodes and to find their own food. We were able to examine a number of stomach contents and found them to consist mainly of vegetable matter, in few instances the presence of starch could be proved, probably from seeds, and in two examples the remains of insects were to be observed, but only in small quantity.

If the Malay house-rat is a derivative of some indigenous wild rat (f.i. *jalorensis*) it would be important to observe what changes will occur after a sufficient lapse of time when these rats cease to be semi-parasitic on man and are compelled to live a wild life. In the first place we may presume that the rats living a more out-door life will become lighter in colour, especially the under parts. There is, however, up till now, not the slightest indication of the lower parts becoming less dark. The specimens caught in 1934 are as dark as or even darker than examples found in 1920. But it is probable that the house-rat acquired the characteristics that distinguish it from the more primitive country-rat already in very remote times, so the reversion to the original type may take a great number of generations during a long period. It is to be hoped that the house-rat on Krakatau will remain isolated and no other allied form or species will be introduced so that it will prove possible to pursue this question further.

As to habits we may suppose that these house-rats change to a more terrestrial life, but although the nails of a few specimens seem to indicate that they become more inclined to burrowing, the still strongly developed pads on

the feet are evidence that the climbing habit is certainly not being abandoned. At night we often saw these rats on the soil or running along the branches of the low trees fringing the beach, apparently searching for food. Once at twilight we observed a rat coming out from the wood and skipping towards the sea but as soon as it encountered the surf-rollers spreading on the sand it quickly ran back to the shelter of the forest. We could not detect nests of the rats in the trees but once we found a female with a litter of young ones under a log, this was at the time Mr. HANDL still lived on the island. After the ruination of his house a rat was detected in a hole at the base of an old tree.

Krakatau N.W. IX 1920, 1 ♀; Krakatau S.E. XII 1919, 1 ♀; IX 1920, 1 ♀, 1 juv.; V 1929, 3 ♀♀; I 1933, 1 ♂, 4 ♀♀; IV 1933, 2 ♂♂, 2 ♀♀; IV 1934, 1 ♂, 1 ♀.

House-rats are also found in and near the native houses on Sebesy, the island in the neighbourhood of the Krakatau group.

Rousettus amplexicaudatus E. GEOFFR.

This species was detected only lately (1933) in a cave on Lang Island.

The very short and adpressed fur of the back is of an umber or sepia colour; head above darker; neck and rump much lighter, isabel colour. Underparts tawny, middle of breast and belly and sometimes the whole under surface, more greyish drab; chin and throat lighter, sparsely haired.

Measurements

Btzg. Mus. No.	3377	3378	3379	3380
	♂	♂	♀	♀
total length	128	130	129	126
head & body	108	110	110	107
tail	20	20	19	19
ear	18	19	17	17
forearm	80	78	79	79
expanse of wings	482	474	470	468

Skull-measurements

total length	36.5	36.3	34.8	34 8
zygomatic breadth	22.2	22.7	20	20.2
rostrum, orbit to nasals	12.3	12	11.9	11.3
least interorb. breadth	8	8	7.1	7.3
cranial width	13.5	14 5	13.3	13.6
width across m^2, extern	10 3	10.6	9.3	9.9
upper teeth-row	13.2	12.8	12.3	12.6
lower teeth-row	14.6	14.7	13.6	14.1

In *R. a. minor* from Java the forearm is much shorter, also the skull-measurements average smaller than in the typical *amplexicaudatus* from Sumatra, although our series consists of individuals coming in this respect nearer to *minor* as is to be expected in forms living in the transitional region between the true ranges inhabited by the two subspecies.

This bat was found to be fairly abundant in a cave in rocky cliffs at the east coast of Lang Island, which could be reached only by boat.

Lang Island, XII 1933, 2 ♂♂, 2 ♀♀.

Cynopterus brachyotis angulatus MILL.

DAMMERMAN, Treubia III 1922, p. 65. IDEM, Krakatau's New Fauna, 4th. Pac. Science Congr. 1929, p. 97.

This species was first found by SUNIER in 1919 both on Krakatau and Verlaten Island. Later on Dr. DOCTERS VAN LEEUWEN collected six more specimens on Krakatau S.E.

In the male the colour of the back is buffy brown-olive, sometimes more rusty; head somewhat darker; sides of neck and breast clay color; underparts buffy brown. Ears narrowly edged by white. Metacarpals and phalanges conspicuously whitish.

The female is darker above, more olive-brown throughout there being hardly any contrast between the colour of the neck and sides of the breast.

Young specimens are more like the female.

Total length of No. 1542 ♂; 116 mm, tail 10 mm.

„ „ „ „ 1543 ♀; 122 mm, „ 10 mm.

Length of ear (all measurements taken from specimens preserved in spirit) 15.5, 16.5, 17, 17, 17.5 and 18 mm.

Forearm: 63.5, 67, 68.5, 69, 69, 69, 71 and 72 mm.

Of the eight specimens three are young.

Skull-measurements

Btzg. Mus. No.	15	1542	16	1543
	♂	♂	♀	♀
total length	32.7	33.2	—	30.3
zygomatic breadth	21	20.3	18.2	20
rostrum, orbit to nasals	8.1	8.3	7.9	7.7
least interorb. breadth	6 5	6.3	6.2	6.1
cranial width	13.7	13.4	12.9	12.9
width across m^1, extern.	9.9	8 9	8.8	9
upper teeth-row	11.2	10.4	10.3	10
lower teeth-row	12.4	11.7	11.2	—

The shape of the teeth and the absence of a cusp in p_4 and m_1 indicates that our species is a member of *Cynopterus* section proper. But than we have to decide whether it belongs to *C. sphinx* (*marginatus*) or *C. brachyotis*. These two species are very similar and can only be distinguished by the length of the ears which is 18 - 20 mm in *C. sphinx* and 13 - 18 mm in *brachyotis*. Now unfortunately none of the measurements given above were taken in the flesh, but even allowing a certain percentage of shrinkage for the preservation in spirit the length of the ear is certainly not more than 18 mm, the minimum length in *C. sphinx*. Moreover the forearm is 74 - 83 mm in *C. s. tithaechilus* (from Sumatra and Java), the only subspecies of *C. sphinx* which need be considered here, and the maximum in our series is 72 mm. Also *tithaechilus* has a much larger skull, 35.5 - 38.5 mm.

So from these data and from the white metacarpals and phalanges contrasting strongly with the dark membrane we refer our specimens to *C. brachyotis*.

We first thought the form had to be referred to *C. sphinx* as we had before 1928 only one adult (from Verlaten Isl.) and one example from the nearby Sebesi Island (X, 1921), of which we had measurements taken in the flesh. The latter specimen, however, having a forearm of 76.5 mm and an ear-length of 20 mm certainly belongs to *C. sphinx tithaechilus*.

If the Krakatau species is *C. brachyotis* the question arises to which subspecies it has to be allocated. From the larger forearm and greater length of skull and rostrum, characters which exclude it from *C. b. brachyotis* from Sumatra and *C. b. javanicus* from Java, we think our form must be *C. b. angulatus*, a subspecies having a very wide range occurring from Assam to Sumatra.

Krakatau S.E., IV 1919, 1 ♀ juv. (leg. A. SUNIER); V 1928, 3 ♂♂, 3 ♀♀ (leg. W. DOCTERS VAN LEEUWEN); Verlaten I., IV 1919, 1 ♂ (leg. A. SUNIER).

Cynopterus horsfieldi minor LYON.

DAMMERMAN, Treubia III 1922, p. 65; IDEM, Krakatau's New Fauna, 4th Pac. Science Congr. 1929, p. 97.

A second species of *Cynopterus* is found on the main island of Krakatau and was lately (1930) also collected on Verlaten Island.

In the male the upper parts are buffy to olive-brown, the head somewhat darker, colour of the sides of the neck and shoulders ferruginous or cinnamon-rufous. Underfur on the back composed of light greyish woolly hairs. Middle area of the ventral surface olive-drab but the sides and other parts rufous, this colour also extending on the underside of the upper arm. Innerside of lower arm and legs sparsely covered with yellowish hairs.

Female much lighter in colour, on the back deep olive, underside greyish olive, sides of the neck, foreneck and shoulders old gold or isabel colour.

Ears dark narrowly margined with white.

Wings also dark with conspicuously whitish metacarpals and phalanges.

Total length of the full-grown male 105 mm, of the semi-adult female 96 mm, forearm in both sexes 71 mm; expanse of wing of the male 487 mm.

Skull-measurements

Btzg. Mus. No.	7 [1])	707	32	2455
	♂	♂	♂	♀
total length	—	33.7	31.5	31.2
zygomatic breadth	—	22.6	21.7	21.1
rustrum, orbit to nasals	6.6	8	6.8	7.3
least interorb. breadth	5.5	6.2	5.5	5.6
cranial width	—	13.6	13.2	12.9
width across m^2, extern.	9.5	9.6	9.4	9.4
upper teeth-row	10.8	10.6	10.3	10.2
lower teeth-row	12.5	12.1	12	11.8

[1]) Skull of No 7 badly smashed.

The species is distinguished from the foregoing one by the larger, more rectangular teeth, the broader palate and the cusps on the third and fourth lower molars (p_4 and m_1).

The series of four specimens contains only one full-grown male (No. 707), the others being semi-adults. This male with a skull-length of 33.7 and a forearm of 73 mm comes within the range of the subspecies *minor*, but otherwise the measurements are not so convincing. *Minor* is recorded from Sumatra whereas the typical *horsfieldi* comes from Java. Probably specimens found in South Sumatra and on islands in the Sunda Straits are intermediate between the subspecies which are very similar, differing only in size.

One specimen was caught in Mr. HANDL's house (1920), the others were found roosting during the day in shrubs.

Krakatau S.E., IV 1920, 1 ♂; IX 1920, 1 ♂ (leg. H. C. SIEBERS); VII 1924, 1 ♂; Verlaten I., VIII 1930, 1 ♀.

Hipposideros diadema E. GEOFFR.

DAMMERMAN, Krakatau's New Fauna, 4th. Pac. Science Congr. 1929, p. 97.

The only example of this insectivorous bat was collected by Dr. DOCTERS AN LEEUWEN on Krakatau East at an altitude of 600 m.

The forearm is 85 mm. From this and from the skull-measurements (see elow) our specimen could as well belong to the subspecies *vicarius* AND., known om Sumatra, Borneo and Celebes, as to the typical *diadema*, recorded from ava. These two subspecies are very closely related and hardly separable.

Skull-measurements (No. 1541)

total length	31.6	mm
zygomatic breadth	18	„
least interorb. breadth	3.6	„
cranial width	11.5	„
anteorbital width	9	„
maxillar width	12.3	„
upper teeth-row	12.6	„
lower teeth-row	13.9	„

Although we are dealing here with a full-grown adult it is certainly not a very old individual as the teeth are very little worn, therefore the specimen is difficult to allocate. Only the smaller size and the small anteorbital width, having a minimum of 9.5 mm in the typical *diadema*, brings our example nearer to *vicarius*. On the other hand the lateral vertical ridges on the front face of the posterior nose-leaf are said to be less conspicuous in *vicarius*, but I cannot find any difference in this respect in Java specimens. Also a small fourth supplementary leaflet on the side of the horseshoe is found both in Java forms and the specimen from Krakatau.

Whether the very slight differences between the two above-mentioned subspecies are really constant enough for justifying their validity must remain undecided until larger series are examined.

Krakatau E., 600 m alt., V 1928, 1 ♀ (leg. W. DOCTERS VAN LEEUWEN); (specimen preserved in spirit, skull extracted).