

STUDIES ON THE FAUNA OF CURAÇAO AND OTHER
CARIBBEAN ISLANDS: No. 35.

FOSSIL RODENTS FROM CURAÇAO AND BONAIRE

by

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with Plates I-III

The fossil remains of rodents described in the present paper are from various localities. The large extinct musk rat *Megalomys* occurs in reddish-brown phosphatic "oölite" fillings of irregular cavities in a marine limestone found by Mr. P. H. DE BUISONJÉ in the north-western part of the Duivelsklip, eastern Curaçao, about 50 m above sea-level. The "oölite" also contains scanty remains of lizards, snakes, and of a bat. Fragmentary molluscs present possibly include *Cerion uva* (L.), a recent, very common, terrestrial species, as well as other gastropods, many opercula of which were found.

Samples of a phosphatic "oölite" deposit collected in 1937 by Dr. P. WAGENAAR HUMMELINCK from an escarpment near Fontein, Bonaire, proved to contain jaws, with teeth, of a genus of hesperomyine rodents, *Thomasomys*; a single snake vertebra; and mollusc remains including what seem to be their coprolites.

Finally, teeth of the South American capybara, *Hydrochoerus*, were found by Prof. Dr. H. J. MAC GILLAVRY and Mr. P. H. DE BUISONJÉ in reddish-brown phosphatic "oölite", deposited after consolidation of the underlying marine limestone and located at a present height of about 160 m above sea-level on the Tafelberg Santa Barbara, eastern Curaçao. No other vertebrates have been recovered from this deposit.

The limestone is considered to be Quaternary in age.

Marine molluscs contained in the Santa Barbara "oölite" have been identified by Mrs. W. S. S. VAN DER FEEN (née VAN BENTHEM JUTTING) and Mr. H. E. COOMANS, independently of each other, as *Livona pica* (L.), *Nerita* cf. *tesselata* Gm., and *Nerita* cf. *versicolor* Gm.

It is of interest to find that the "oölite" deposits of Duivelsklip and Santa Barbara contain the same species of land crab, which has been identified by Dr. L. B. HOLTHUIS as *Coenobita clypeatus* (Herbst) – a land hermit crab which is common all over the West Indies and is frequently met with in Curaçao. *Coenobita clypeatus* is found from the high-tide mark on the coast to far inland. It lives in the shells of various species of gastropod molluscs, but seems to prefer those of *Livona pica*.

Permission to collect the samples of "oölite" the fossil contents of which are described in the present paper was kindly given by the "Mijn-Maatschappij Curaçao", manager Mr. R. J. MESNEY, and by Dr. W. P. MAAL, owner of Fuik Plantation. I am much indebted to Prof. Dr. H. J. MAC GILLAVRY and to Dr. J. H. WESTERMANN for passing the fossil rodent material to me for description. My thanks are due to Mr. R. W. HAYMAN of the British Museum (Natural History), for kindly sending me measurements of the type specimen of *Megalomys luciae* (Major), as well as other information pertaining to the recent rodents of the Antilles. I am also very grateful to Mr. P. H. DE BUISONJÉ, who spent a great deal of time in dressing the fossil remains from the block of "oölite" collected at Duivelsklip, as well as those from the samples from the escarpment near Fontein, Bonaire, by means of acetic acid, thus extracting even the most delicate specimens from the matrix, which would have been impossible by mechanical methods. It was found that the concretions in the Duivelsklip matrix contained not only entire teeth and very small bones, but also tooth and bone fragments. The largest single fragment dressed from the block is only 15 mm long; most of the fossil specimens do not exceed 5 mm in diameter. How these small specimens found their way into the deposit is a moot question that I shall not go into at present.

The fossil material described below is preserved in the Geological Institute of the University of Amsterdam; the registration numbers are given in each case. The photographs have been taken by Mr. H. F. ROMAN, the text figure is by Mr. H. HEIJN, both of the Rijksmuseum van Natuurlijke Historie.

All measurements recorded in this paper are in mm, unless otherwise stated.

Megalomys curazensis nov. spec. from Curaçao

DIAGNOSIS: An oryzomyine rodent of large size; length M^{1-3} , 7.6 mm; length M_{1-3} , 7.9 mm, on an average. Width of palate between M^1 s less than combined width of right and left M^1 . Major and minor folds remain open marginally throughout most of the life of the teeth. Major folds well developed in all molars but short in M^3 . Minor folds well developed in M^1 and M_1 , reduced in M^2 and M_2 , obsolete or absent in M^3 and M_3 . Primary and secondary folds tend to become isolated from marginal enamel with prolonged wear. First

primary folds well developed in M^{1-2} and M_{1-3} ; internal portion isolated in M^3 . Second primary folds well developed in M^{1-2} and M_{1-2} , reduced in M^3 and M_3 . Anterior median folds rare in M^1 and M_1 , never continuous with anterior internal folds. Anterior secondary fold (M^1) and anterior primary fold (M_1) small but distinct, marking off anterior cingula. First secondary folds in M^{1-3} and second secondary folds in M_{1-3} always well defined. Mesoloph fused with mesostyle, mesolophid fused with mesostylid. Second secondary folds distinct but small in M^{1-3} , marking off posterior cingula. First secondary folds distinct in M_1 but reduced or obsolete in M_{2-3} . Hypoconid depressed posteriorly. Enterostyles incipient or absent, ectostylids present. M^{2-3} with three roots, one inner and two outer; M^1 has, in addition, an anterior root; M_{1-3} with one anterior and one posterior root; accessory intermediate roots may develop in M^1 and M_1 . Incisors large, ungrooved.

HOLOTYPE: The M^{1-2} dext., E 3187, described and figured in the present paper.

LOCALITY: Duivelsklip, eastern Curaçao, Netherlands Antilles.

AGE: Presumably Pleistocene.

DESCRIPTION OF THE HOLOTYPE SPECIMEN, E 3187

The most complete fossil specimen recovered from the block of "oölite" from Duivelsklip, Curaçao, is a fragment of a right maxillary with M^{1-2} in situ (pl. I fig. 1). At the anterior end of the fragment the root supporting the anterocone of M^1 is exposed along most of its length. Medially, a small portion of the palate is preserved, showing part of the right lateral palatal groove but nothing of the borders of the incisive foramen or of the posterior palatine foramen. At the level of M^1 the fragment is broken off along the median palatal suture, indicating a width of the palate between the M^1 s of 4.2 mm, which is less than the combined width of right and left M^1 (5.2 mm). Laterally, the posterior boundary of the anterior zygomatic root begins to curve outward on a level with the middle of M^1 , but as its anterior border has not been preserved it is impossible to determine the least anteroposterior diameter of the zygomatic plate. The lateral border of the palate is seen to curve gently inward just behind M^2 , indicating a transversely narrowed M^3 that is, however, missing in the specimen and has left only the impression of its palatal root.

The two molars are excellently preserved; for an explanation of the various terms used in the description of the teeth reference should be made to the stylized diagrams of enamel patterns on page 5.

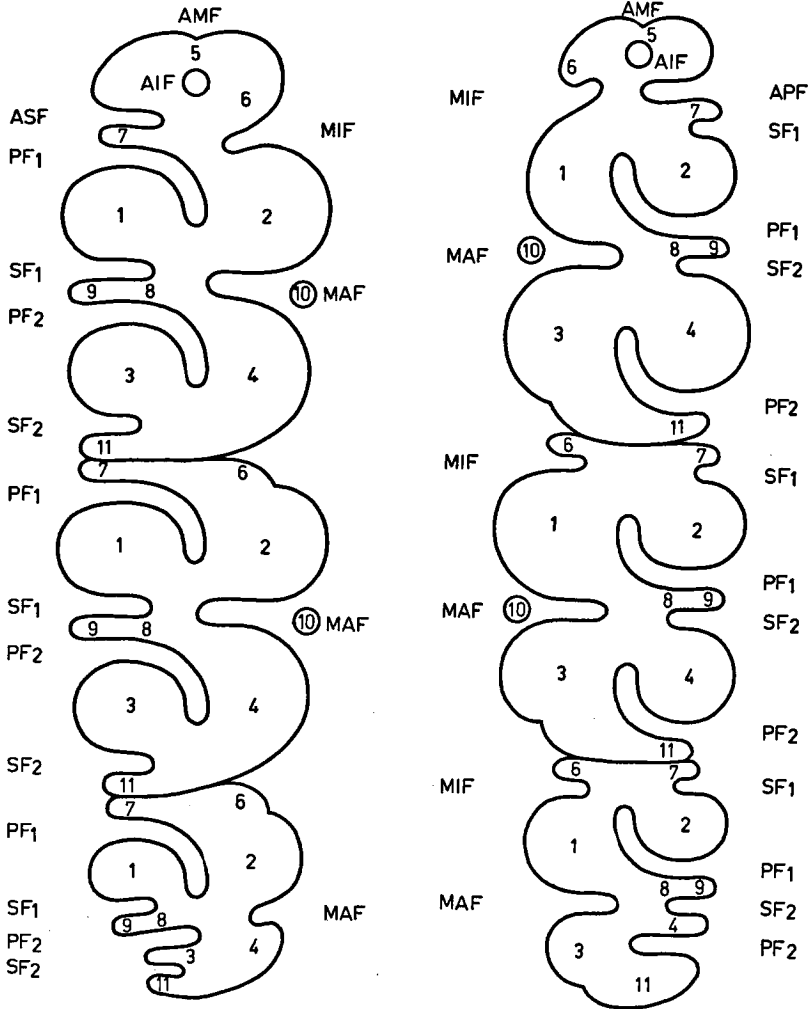
The anterior molar, M^1 dext., is moderately worn, and consists of an anterior lobe (anterocone) and two pairs of cusps, transversely placed. The internal cusps are larger than those on the external side, and are separated from the latter by

NAMES OF CUSPS, LOPHS, AND CINGULA

<i>Upper</i>	<i>Lower</i>
1. Paracone	1. Protoconid
2. Protocone	2. Metaconid
3. Metacone	3. Hypoconid
4. Hypocone	4. Entoconid
5. Anterocone	5. Anteroconid
6. Anteroloph	6. Anterolophid
7. Anterior cingulum	7. Anterior cingulum
8. Mesoloph	8. Mesolophid
9. Mesostyle	9. Mesostylid
10. Enterostyle	10. Ectostylid
11. Posterior cingulum	11. Posterior cingulum

NAMES OF FOLDS (*upper and lower*)

MAF	Major fold
MIF	Minor fold
PF1	First primary fold
PF2	Second primary fold
SF1	First secondary fold
SF2	Second secondary fold
AIF	Anterior internal fold
AMF	Anterior median fold
APF	Anterior primary fold
ASF	Anterior secondary fold



Stylized diagrams of enamel patterns of upper right and lower left molar series; nomenclature after WOOD & WILSON (1936) and HERSHKOVITZ (1944). For explanation see opposite page.

distinct enamel folds, which enter the crown externally, and curve inward and backward in front of paracone and metacone respectively. These two primary folds have just about lost the communication with the marginal enamel. On the internal side there are two enamel folds extending less far into the crown; these, the minor and the major folds, open broadly to the internal wall of the crown. Their entrances are low down on the crown, and consequently they will never become isolated from the margin. The plane of wear is distinctly oblique, the internal side being more worn down than the external.

More detailed examination of the specimen reveals the following. The anterocone is asymmetrical, the internal part being rounded and broader anteroposteriorly than the external part. It will be observed that the anterocone thereby tends to duplicate in appearance the structure of the transversely placed pairs of cusps behind. The external part is pinched in by the anterior secondary fold; between this fold and the first primary fold behind there is an enamel projection: the anterior cingulum. The anterior surface of the anterocone is slightly depressed in the median line near the occlusal surface, but becomes gently rounded from side to side near the base of the crown; this median depression represents the anterior median fold, which is evidently most marked near the top of the crown. There is an enamel island in the centre of the anterocone, which is elongated transversely, and may have formed part either of the anterior secondary fold or of the anterior median fold in a less advanced stage of wear.

The crown is widest transversely over the anterior pair of main cusps, a feature which is mainly due to the bulging-out of the protocone internally. The minor fold, between anteroloph and protocone, is well developed and slightly curved forward at its end. The major fold, behind the protocone, is longer, transverse in its course, and extends outward just about to the median line of the crown. On the external side, the first primary fold (between the anterior cingulum and the paracone) curves inward and then backward well beyond the median line; its entrance forms a pass just one mm above the crown base, and has almost been reached by wear, as a result of which the fold becomes isolated from the crown margin. Behind the paracone there is an enamel fold that is transverse in its course; it extends inward only to the median line of the crown, and is already constricted off from the external margin: this fossette represents the first secondary fold. Between the latter fold and the second primary fold behind there is a continuous strip of enamel representing mesoloph and mesostyle.

The posterior pair of cusps, slightly narrower transversely than the pair in front of it, is essentially similar in structure. The second primary fold, between mesoloph and metacone, closely resembles the first, and is likewise almost cut off from the external marginal enamel. Behind the metacone, in the postero-external angle of the crown, we observe a distinct second secondary fold, marking off the posterior cingulum.

The anteroposterior diameter of the crown of M^1 is 3.5 mm, the greatest width is 2.6 mm.

The M^2 of the present specimen has all the characters of an M^1 without the anterocone, but is, of course, in a slightly less advanced stage of wear. The crown is wider anteriorly than posteriorly. The minor fold is only a faint depression at the antero-internal angle of the crown, and the anterior cingulum forms the antero-external angle. The first and second primary folds are still open externally, and appear to be slightly less curved than those of M^1 . The first secondary fold is dis-

tinctly expanded at its inner end, and there is a tiny spur of enamel projecting into it from the posterior border of the paracone. It is just closed off from the external margin. Between the first secondary fold and the second primary fold we again find a transverse strip of enamel, the mesolophostyle complex. The second secondary fold is deeper than that in M^1 , and the posterior cingulum is therefore quite distinct. The posterior surface of the crown of M^2 is rounded behind instead of nearly flat as in M^1 , because of less interproximal wear; there is as yet hardly any trace of a contact facet with M^3 .

The length of the crown of M^2 is 2.6 mm, the anterior width 2.3 mm.

The characters that can be observed in this single specimen point to its belonging to the cricetine rodents, more specifically to the group of oryzomyine rodents characterized by the presence of anterior and posterior cingula as well as by a fused mesoloph and mesostyle (GOLDMAN, 1918, p. 12 (this author calls the anterior cingulum of our terminology the "secondary parastyle" (M^1) or "parastyle" (M^2)); GYLDENSTOLPE, 1932, p. 11 (idem); HERSHKOVITZ, 1944, p. 12-13, 1955, p. 654). However, in addition to the fine specimen just described, numerous isolated teeth have been recovered from the block of "oölite" from Duivelsklip, representing all the upper and lower molars evidently of the same species as that to which the M^{1-2} dext. belong, and yielding much additional information. It seems best, therefore, to defer comparison of the present fossil species with the recent and subfossil oryzomyines until all the material now available has been considered.

UPPER MOLARS

Including the specimen described above there are 33 specimens of the first upper molar, viz., 17 from the right, and 16 from the left side (E 3187-E 3219). These specimens display a certain amount of variation in size, as is shown in table 1. All the M^1 s are remarkably similar in structure, differing only in unimportant details depending upon the stage of wear, or in development of the anterior median fold and of enterostyles. The roots are more or less completely preserved in a number of specimens; these could not be studied in the type.

The anterior internal fold is isolated from the marginal enamel in every specimen, no matter how slightly worn, but in several molars it is barely closed off from the anterior secondary fold entering the crown externally, as can be seen in a slightly worn M^1 sin. (E 3204) shown on pl. I fig. 5. Two rather large and moderately worn right M^1 s (E 3188 and E 3189; pl. I figs. 2-3) do not show any indication of an anterior median fold, but in a much worn left M^1 (E 3205; pl. I fig. 4) the anterior surface of the anterocone is distinctly flattened. In a few specimens (E 3208 and E 3213) there is a faint cingular ledge on the anterior surface of the anterocone, and in one specimen (E 3193) there is a true anterior median fold, which divides the anterocone into two conules but does not, however, communicate with the anterior internal fold.

In a very few molars only (e.g., E 3203), enterostyles (not shown in the type) are seen as very tiny enamel points, blocking the entrance to the major fold.

There are three main roots in M^1 : the largest is located internally, supporting protocone and hypocone; the second largest is that of the anterocone, and the third is that of the metacone. In addition, there are either one or two much smaller roots supporting the paracone (shown in specimen E 3204; pl. I fig. 5).

TABLE 1

Measurements of M¹ of *Megalomys curazensis* nov. spec. (E 3187-E 3219)

No. of specimen	1	2	3	4	5	6	7	8	9	10	11
Anteroposterior	3.4	3.5	3.8	3.4	3.4	3.8	3.5	3.2	3.2	3.3	3.2
Transverse	2.6	2.6	2.5	2.2	2.5	2.6	2.3	2.3	2.2	2.2	2.3
No. of specimen	12	13	14	15	16	17	18	19	20	21	22
Anteroposterior	3.6	3.4	3.1	3.3	3.3	3.3	3.2	3.5	3.4	3.5	3.6
Transverse	2.6	2.4	2.2	2.2	2.4	2.2	2.2	2.6	2.3	2.4	2.5
No. of specimen	23	24	25	26	27	28	29	30	31	32	33
Anteroposterior	3.2	3.2	3.3	3.2	3.0	3.0	3.4	3.3	3.3	3.1	3.3
Transverse	2.3	2.4	2.3	2.4	2.1	2.0	2.3	2.3	2.4	2.2	2.4

The second upper molar, M², is somewhat less well represented than is M¹. There are 27 entire or almost entire specimens; nos. 1-17 from the right, and nos. 18-27 from the left side (E 3187 and E 3220-E 3245). No. 1 is that in the holotype. M² is, again, rather constant in its characters. In early stages of wear the first secondary fold is expanded at its inner end (E 3221; pl. II fig. 1); it is isolated externally earlier than the two primary folds, and recedes more and more from the margin, as can be seen in a much worn left M² (E 3236; pl. II fig. 2). The mesolophostyle complex is distinct in all specimens, and so is the anterior cingulum. In the most worn specimens the second secondary fold has disappeared entirely; in the specimen on pl. II fig. 2 (E 3236) it is represented by a tiny enamel island postero-externally. Enterostyles are so weak as to be practically absent. The major fold remains open internally throughout the life of the tooth, but the minor fold, which is but faintly developed even in slightly worn M²s, is worn out in old age.

The roots of M² are three in number: the largest is elongated anteroposteriorly in cross section and is located internally; the second largest supports the metacone; and the third is that of the paracone. An incipient accessory root, placed postero-internally from the paracone root, is developed in E 3225. The measurements of the specimens are given in table 2.

TABLE 2

Measurements of M² of *Megalomys curazensis* nov. spec. (E 3187 and E 3220-E 3245)

No. of specimen	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Anteroposterior	2.6	2.5	2.2	2.5	2.4	2.2	2.5	2.6	2.4	2.4	2.2	2.3	2.3	2.4
Transverse	2.3	2.4	2.1	2.3	2.2	2.0	2.1	2.2	2.1	2.3	2.2	1.9	2.0	2.2
No. of specimen	15	16	17	18	19	20	21	22	23	24	25	26	27	
Anteroposterior	2.3	2.2	2.2	2.4	2.2	2.3	2.3	2.2	2.3	2.2	2.3	2.2	2.1	
Transverse	2.2	2.1	2.3	2.2	2.0	2.1	2.2	2.1	2.3	2.0	2.2	2.0	2.0	

The last upper molar, M³, is built on the same plan as is M², but is smaller both

ways; its posterior portion is much reduced. The first primary fold is isolated from its internal portion even in the least worn specimens, the internal portion forming a conspicuous rounded enamel island. The second primary fold is markedly reduced, being transverse in its course and even shorter than the second secondary fold behind it (M^3 dext. E 3246; pl. II fig. 3). In E 3247 (pl. II fig. 4) the second primary and second secondary folds have coalesced internally. The first secondary fold is rather variable, and in some cases (as in E 3262, an M^3 sin. (pl. II fig. 5), and in E 3269) appears duplicated. In E 3247 (pl. II fig. 4) it is cut into by a posterior projection from the paracone. The mesoloph-mesostyle ridge, however, is always present. The major fold is short but very distinct, the minor fold obsolete. M^3 , like the other upper molars, has one internal and two external roots; the internal root is not, however, enlarged in relation to the others.

Of the last upper molar we have 25 specimens, the measurements of which will be found in table 3. Nos. 1-16 are from the right side, the other specimens are from the left (E 3246-E 3270).

TABLE 3
Measurements of M^3 of *Megalomys curazensis* nov. spec. (E 3246-E 3270)

No. of specimen	1	2	3	4	5	6	7	8	9	10	11	12	13
Anteroposterior	2.0	1.9	2.0	2.0	1.9	2.0	1.9	1.9	2.1	2.1	2.1	2.1	1.8
Transverse	1.8	1.7	1.7	1.7	1.7	1.8	1.7	1.7	2.0	1.9	1.9	1.9	1.7
No. of specimen	14	15	16	17	18	19	20	21	22	23	24	25	
Anteroposterior	2.0	2.1	1.9	1.8	1.8	2.0	2.0	2.1	2.0	2.0	2.0	1.7	
Transverse	1.7	1.9	1.8	1.7	1.7	1.6	1.8	1.9	1.8	1.8	1.7	1.6	

LOWER MOLARS

Of the lower molars only a few specimens still remain in situ in portions of the mandible. A much worn left M_2 , incomplete antero-internally, is in situ in a left ramus of the mandible the incisor of which is, however, gone. Neither the height of the body of the mandible nor the length of the diastema can be given, but the alveoli of M_1 and of M_2 are visible, revealing an alveolar length M_{1-2} of 7.8 mm. The mental foramen, on the labial side in front of the M_1 , is just anterior to the masseteric crest; nothing of the ascending portion of the ramus is preserved. A right M_1 and M_2 (M_1 incomplete anteriorly) are in situ in a mandible fragment the height of which cannot be given either. All the remaining specimens of lower molars are isolated, many with their roots partially preserved.

Of M_1 only 17 entire or almost entire specimens have been recovered, 11 of them from the right side (E 3271-E 3281, E 3283-E 3288). This tooth consists of an anterior lobe (anteroconid) behind which follow two transverse pairs of cones, those on the external side being larger than the internal. The two primary folds enter the crown internally, behind metaconid and entoconid respectively, and curve outward and forward. On the external side the minor and major folds mark the threefold division of the crown; these folds are less deep, and have lower entrances, than the primary folds, just as in the upper molars. The crown of M_1 narrows distinctly from back to front.

The anteroconid of M_1 has a central depression, the anterior internal fold; this is elongated transversely, and is of great relative depth, so that it remains as an enamel island even in the most worn specimens (e.g., M_1 sin. E 3285; pl. II fig. 8). The anterior primary fold, which enters the anteroconid internally, is still shown in this specimen as a much smaller island, just internal to the central island. In less worn specimens, such as the M_1 sin. E 3283 (pl. II fig. 7), the anterior primary fold is seen to extend from the internal margin into the central depression (the anterior internal fold). The specimen just mentioned also shows a slight but distinct depression in the anterior wall of the anteroconid; this is the anterior median fold, only exceptionally apparent in molars in more advanced stages of wear. On the external side of the anteroconid only the minor fold is seen, separating the anterolophid from the protoconid. It is curved forward at its end, as shown both in the slightly worn and in the much worn left M_1 already referred to.

On the internal side, just in front of the metaconid, there is a small fold, the first secondary fold; it is just behind the anterior primary fold already referred to above. Between the two last-mentioned folds the anterior cingulum is found, distinct in all stages of wear (cf. pl. II figs. 6-9). The first primary fold, behind and medially in relation to the metaconid, may be confluent with the first secondary fold, thus marking off the whole of the metaconid. Between metaconid and entoconid there is a transverse ridge of enamel, distinct from both cusps; this enamel ridge is the mesolophid-mesostylid complex. In two moderately worn M_1 s, one from the right side (E 3271; pl. II fig. 6) and one from the left side (E 3284; pl. II fig. 9), this distinctive character is readily seen. In the much worn M_1 sin. E 3285 (pl. II fig. 8) the second secondary fold which marks the mesolophid off posteriorly is just visible as a very small transverse island. The last fold to be observed on the internal side of the crown is the second primary fold, curving outward and forward behind the entoconid. It marks off the posterior cingulum.

On the external side, the major fold enters the crown between protoconid and hypoconid; it is very wide at its entrance and just on a level with the fused mesolophid and mesostylid. There is an enamel point at its entrance, a low cingular elevation called the ectostylid. The major fold is isolated from the marginal enamel only in the most advanced stages of wear (e.g., in E 3275 and E 3282; the last-mentioned is an incomplete M_1 dext. not included in table 4). The posterior surface of the hypoconid shows a weak depression or "dimple", a feature very characteristic of the lower molars.

TABLE 4
Measurements of M_1 of *Megalomys curazensis* nov. spec.
(E 3271-E 3281, E 3283-E 3288)

No. of specimen	1	2	3	4	5	6	7	8	9
Anteroposterior	3.3	3.6	3.2	3.0	3.4	3.0	3.2	3.1	3.0
Transverse	2.2	2.2	2.1	2.0	2.0	2.0	2.1	2.0	1.9
No. of specimen	10	11	12	13	14	15	16	17	
Anteroposterior	3.3	3.0	3.1	3.1	3.2	3.3	3.4	3.2	
Transverse	2.1	2.0	2.2	2.2	2.1	2.1	2.3	2.1	

The root system of the anterior lower molar is as follows. Below the anteroconid there is a large root, either rounded or antero-posteriorly elongated in cross section. Behind, supporting hypoconid and entoconid, there is a transversely extended root. Between these two main roots are a pair of accessory roots; in a few specimens there appear to be even three accessory roots, of which the central is the smallest.

The lower second molar is the best represented tooth in the collection from Duivelsklip. There are 35 specimens; nos. 1-20 are from the right side, and nos. 21-35 from the left (E 3289-E 3323). Four specimens, all from the right side and in different stages of wear, show the characteristic features of the tooth (E 3289-E 3292; pl. III figs. 1-3, 6). In the unworn state, the crown exhibits a reduced minor fold antero-externally, marking off the anterolophid, which remains distinct even in old age. The first secondary fold, marking off the anterior cingulum, is, however, obsolete in the unworn crown although it may be seen as an enamel pit in the later stages figured, especially in E 3290. The first primary fold is closed off from the internal marginal enamel already in the unworn crown E 3289, and so is the second primary fold. The second secondary fold, which is behind the mesolophid-mesostylid complex, is likewise closed off internally. Only the major fold remains open during most of the life of the tooth. In much-worn molars the ectostylid invariably developed at the entrance of the fold is touched by wear, upon which even this fold loses its continuity with the marginal enamel. The postero-external "dimple" of the crown can be observed in most specimens. The M_2 dext. E 3293 is represented in external view on pl. III fig. 5; it shows the height of the (unworn) crown, the ectostylid at the entrance of the major fold, the high anterolophid in front, and the "dimple" in the posterior surface of the hypoconid.

There are only two main roots to M_2 , one below the anterior, and one below the posterior pair of cusps; accessory roots have not been observed.

TABLE 5

Measurements of M_2 of <i>Megalomys curazensis</i> nov. spec. (E 3289-E 3323)												
No. of specimen	1	2	3	4	5	6	7	8	9	10	11	12
Anteroposterior	2.4	2.5	2.3	2.5	2.5	2.3	2.3	2.4	2.5	2.2	2.4	2.5
Transverse	2.1	2.3	2.0	2.2	—	2.2	2.0	2.1	2.1	2.0	2.0	2.3
No. of specimen	13	14	15	16	17	18	19	20	21	22	23	24
Anteroposterior	2.6	2.5	2.3	2.3	2.4	2.4	2.5	2.5	2.4	2.3	2.5	2.5
Transverse	2.2	2.1	2.1	2.0	2.1	2.2	2.1	2.1	2.2	2.0	2.3	2.2
No. of specimen	25	26	27	28	29	30	31	32	33	34	35	
Anteroposterior	2.2	2.4	2.4	2.2	2.6	2.4	2.3	2.4	2.5	2.4	2.3	
Transverse	1.9	2.0	2.0	2.0	2.2	2.1	2.0	2.2	2.1	2.0	2.1	

Of the last lower molar 30 specimens are available, 17 from the right, and 13 from the left side (E 3324-E 3353). In relation to the second molar it is less reduced than the upper last molar. The antero-internal pit that represents the first secondary fold is visible in both slightly and much worn specimens (E 3341 and E 3343, both M_3 sin.; pl. III figs. 4, 7). The first primary fold is shaped like that in M_2 , but the second primary fold is reduced. The second secondary fold, and the fused mesolophid.

and mesostylid in front of it, are distinct in all the specimens. The minor fold, antero-externally, is seen only in less than one-half of the specimens, and is very weakly developed, if present at all. The major fold, wide open externally, extends about half-way across the crown, and has an ectostylid at its entrance. The postero-external "dimple" is incipient but discernible in slightly worn crowns.

The roots are two in number, the anterior is extended transversely, and the posterior is extended obliquely from antero-internal to postero-external; the latter is the heavier.

TABLE 6
Measurements of M_3 of *Megalomys curazensis* nov. spec. (E 3324-E 3353)

No. of specimen	1	2	3	4	5	6	7	8	9	10
Anteroposterior	2.2	2.1	2.2	2.2	2.1	2.5	2.2	2.4	2.4	2.3
Transverse	1.8	1.9	1.7	1.8	1.7	2.0	1.8	2.0	2.0	1.9
No. of specimen	11	12	13	14	15	16	17	18	19	20
Anteroposterior	2.2	2.2	2.4	2.5	2.2	2.1	2.2	2.1	2.1	2.4
Transverse	1.9	1.7	1.8	2.0	1.7	1.8	1.9	1.8	1.7	1.9
No. of specimen	21	22	23	24	25	26	27	28	29	30
Anteroposterior	2.3	2.1	2.3	2.3	2.3	2.2	2.5	2.1	2.3	2.2
Transverse	1.8	1.9	1.9	1.9	1.8	1.7	2.0	1.7	1.8	1.8

INDIVIDUAL VARIATION IN SIZE OF FOSSIL MOLARS

As can be seen from tables 1-6, adequate samples are available of each upper and lower molar of *Megalomys curazensis* nov. spec. Hence, it has been found practicable to employ some statistics.

Table 7 gives the number of variates (n), the ranges of variation, and the means (M) of anteroposterior and transverse diameters. The standard deviation

$\sigma = \sqrt{\frac{\sum e^2}{n-1}}$, in which e is the deviation from the mean found for every single

variate. The coefficient of variation $C = \frac{\sigma \times 100}{M}$.

The variation coefficients are higher in the upper than in the lower molars. The most variable tooth is M^2 , the least variable, M_2 . In both M^1 and M_1 the length is more variable than the width; the reverse is the case in M^2-3 and M_2-3 . The variation coefficients vary only from about $4\frac{1}{2}$ to $6\frac{1}{2}$, figures typical of linear dimensions of functional hard parts in mammals, in respect of which the great majority of such coefficients lie between about 3 and 10 (SIMPSON, 1953, p. 74).

It follows from these figures that the Duivelsklip block contained a fairly homogeneous sample of the whole population of *Megalomys*. There is no evidence that more than one species is present.

TABLE 7
Statistical data on molars of *Megalomys curazensis* nov. spec.

	n	range	M	σ	C
M ¹ , anteroposterior	33	3.0-3.8	3.3	0.19	5.8
transverse	33	2.0-2.6	2.3	0.11	4.8
M ² , anteroposterior	27	2.1-2.6	2.3	0.14	6.1
transverse	27	1.9-2.4	2.1	0.14	6.7
M ³ , anteroposterior	25	1.7-2.1	2.0	0.12	6.0
transverse	25	1.6-2.0	1.8	0.11	6.1
M ₁ , anteroposterior	17	3.0-3.6	3.2	0.17	5.3
transverse	17	1.9-2.3	2.1	0.10	4.8
M ₂ , anteroposterior	35	2.2-2.6	2.4	0.11	4.6
transverse	34	1.9-2.3	2.1	0.10	4.8
M ₃ , anteroposterior	30	2.1-2.5	2.3	0.13	5.7
transverse	30	1.7-2.0	1.8	0.11	6.1

INCISORS

A number of incisor fragments have also been recovered. Of these, none is grooved in front; the faces of all specimens are smooth. Ten specimens of upper incisors vary but slightly in diameters, as is shown in table 8.

TABLE 8
Measurements of upper incisors of *Megalomys curazensis* nov. spec. (E 3354-E 3363)

No. of specimen	1	2	3	4	5	6	7	8	9	10
Anteroposterior	2.6	2.8	3.0	2.4	2.6	2.7	2.6	2.9	2.7	2.7
Transverse	—	1.7	—	1.3	1.7	1.7	1.5	1.7	1.6	1.7

Two sizable fragments of lower incisors, one from the right and one from the left side, measure 2.6 by 1.6 mm, and 2.8 by 1.6 mm, respectively, in diameters. The fragments are not sufficiently long to show the recurvature, if any (E 3364-E 3365).

POSTCRANIAL SKELETON

Among the bone fragments which presumably all formed part of the skeleton of the present species, the following may be briefly mentioned: a few incomplete lumbar and caudal vertebrae of uncertain serial position (E 3366-E 3367); the distal part of the shaft of a left humerus, without the trochlea, preserved upward as far as the deltoid process (E 3368); two proximal fragments of ulnae with the olecranon incomplete (E 3369); the acetabular portion of a right os coxae (E 3370); various distal ends of femora, greatest distal width in two specimens 6-7 mm (E 3371); a portion of the shaft of a right tibiofibula, diameter of tibia just above

point of fusion with fibula: 2.7 by 2.1 mm (E 3372); two distal epiphyses of tibiofibulae (E 3373 and E 3374); three entire astragali (one right, two left), proximal width 3.1–3.3 mm, greatest (medial) length 4.6–5.0 mm (E 3375–E 3377); a right calcaneum at least 9 mm high, tuber incomplete (E 3378); a metatarsal without proximal end, length as preserved 15 mm, distal width 2.2 mm (E 3379). (The last is the longest single fragment dressed from the block.) Furthermore, there are a number of carpal and tarsal bones, metapodials, and phalanges of various sizes the exact position of which remains uncertain (E 3380).

COMPARISON OF *Megalomys curazensis* NOV. SPEC.
WITH OTHER ORYZOMYINE RODENTS

The diagnosis of the present species given on p. 2–3 of this paper leaves no shadow of doubt that it has to be classed with the oryzomyine rodents. The distinctive characters of this group are the presence of anterior and posterior cingula, and of a mesolophostyle complex (HERSHKOVITZ, 1944, p. 12–13; 1955, p. 654). The oryzomyines form a branch of the Tribe of Hesperomyini or New World mice (Cricetinae), which includes five genera, viz., *Oryzomys*, *Megalomys*, *Neacomys*, *Scolomys*, and *Nectomys*. Only the last-mentioned of these has been the subject of recent revision (HERSHKOVITZ, 1944).

The cranial and external characters of the fossil Curaçao rat are unknown, and consequently it is necessary to rely exclusively on the dental characters for identification purposes. From a comparison of the fossil teeth with those of *Nectomys squamipes* (Brants), several skulls of which are in the Leiden Museum collection, it is clear that our fossil does not belong to *Nectomys*. Not only are the molar crowns higher in *Nectomys*, but they are also characterized by a fused mesostyle and paracone in the upper molars, and by a fused mesostylid and entoconid in the lower molars (HERSHKOVITZ, 1944, p. 19), characters that do not obtain in the fossil rat from Curaçao. In their relatively low crowns the fossil molars agree with those of *Oryzomys*, the central and most inclusive genus of oryzomyine rodents. *Oryzomys*, which comprises one hundred and eighty odd species, ranges throughout South America from southern Patagonia northward, the Galápagos Islands, Central America, Mexico, Lower California, Texas, Alabama, Georgia, Florida, and north to New Jersey (ELLERMAN, 1941, p. 340). The only records

of the genus from the Caribbean islands known to date are *Oryzomys antillarum* THOMAS (1898, p.177) from Jamaica, *Oryzomys victus* THOMAS (1898, p. 178) from St. Vincent, and *Oryzomys* spec. from Curaçao and Margarita (WAGENAAR HUMMELINCK, 1940, p. 69). The Jamaican and St. Vincent species are believed to be extinct, while the Curaçao and Margarita specimens are mandibles obtained from cave deposits, no living animals having been found ¹). *Oryzomys* undoubtedly once had a much more extensive range in the Caribbean area; it is generally considered that its extermination in the islands of the Caribbean is of very recent date, following the introduction of *Rattus* and of the mongoose from the Old World.

An interesting observation made by Dr. H. E. ANTHONY while exploring cave deposits in Jamaica in 1919-1920, and related by KOOPMAN & WILLIAMS (1951), is as follows. A number of different layers could be distinguished within the caves, the most superficial of which were the "*Rattus* layers". Immediately below these came the "*Oryzomys strata*", in which the bones were stained a browner colour and had a less fresh appearance than those in the true surface layers. "The *Oryzomys* were invariably old and rotten and not on the surface with the more recent *Epimys* (*Rattus*) material" (l.c., p. 3).

The difference in degree of hypsodonty between *Oryzomys* and *Nectomys* has already been observed by WINGE (1887, p. 12, 182, pl. III fig. 10a (*Calomys laticeps* = *Oryzomys*) and fig. 12a (*Nectomys squamipes*); see revised nomenclature in COUTO, 1946). As noted by GOLDMAN (1918, p. 13), in *Oryzomys* the molar crowns

¹) I have examined the material on which HINTON and HAYMAN's record of *Oryzomys* spec. from Curaçao (in WAGENAAR HUMMELINCK, 1940, p. 69) is based. It consists of two mandibular rami with M_3 in situ, found in the cave of Hato, Curaçao, by Dr. P. WAGENAAR HUMMELINCK in 1936. The specimens are now in the Zoological Museum at Amsterdam, and have been kindly loaned to me by Mr. P. J. VAN DER FEEN. The shape of the mandible and the structure of M_3 undoubtedly resemble those of *Oryzomys*, but a specific identification would seem impossible. The alveolar length M_{1-3} is 5.4 mm, which puts it among the robust forms of the genus. M_3 measures 1.7 by 1.2 mm. M_{2-3} are two-rooted, M_1 has two accessory intermediate roots. The fact that the major fold of M_3 extends less than half-way across the crown (pl. II fig. 10) indicates that the Curaçao cave specimens belong to the *O. palustris* group, which is known from Central America, Mexico, and the southern United States, and which also includes the Jamaican *Oryzomys* (GOLDMAN, 1918, p. 15-16). It is interesting to note that *Rattus*, generally considered a post-Columbian intruder in the West Indies, has also been obtained from the cave of Hato: the Leiden Museum possesses three mandibles and two maxillae labelled Cave of Hato, Curaçao, which were collected by HUMMELINCK in 1936. These jaws are rather fresh in appearance, and belong to *Rattus rattus* (L.) subsp. One of the *Oryzomys* jaws is encrusted; the other looks as fresh as the *Rattus* specimens. Dr. HUMMELINCK informs me that no evidence of stratification of the cave deposits of Hato has been found: both the *Rattus* and the *Oryzomys* were picked up by him from the surface on the same spot and on the same day. The cave of Hato, which is easily accessible, should be thoroughly explored; *Oryzomys* is no longer extant on Curaçao, and remains of other recently extinct animals are likely to turn up in this cave.

are, on the whole, lower, but the cusps are more distinct than in *Nectomys*; the same difference is noted by GYLDENSTOLPE (1932, p. 11, 66) and by ELLERMAN (1941, p. 337-338). As stated above, the fossil rat molars from Curaçao have the relatively low crowns found in *Oryzomys*, a number of skulls of different South American species of which are available for direct comparison in the Leiden Museum collection. Structurally, the molars of *Oryzomys* resemble those of the fossil Curaçao rat in detail, save for individual characters pertaining to enterostyles and other secondary features ¹).

There is little difference between the molar teeth of the various genera of oryzomyine rodents exclusive of *Nectomys*, except in the matter of size. According to the tables of GYLDENSTOLPE (1932, p. 136-137), *Oryzomys* proper varies in length M_1-3 from 3.2 to 6.3 mm. *Neacomys* has a dentition like that of *Oryzomys* but smaller in proportion (GYLDENSTOLPE, l.c., p. 34); length M_1-3 2.5-3.1 mm (l.c., p. 138). *Scolomys* has a dentition "apparently as in *Neacomys*" (l.c., p. 35), but smaller still; length M_1-3 2.6 mm (l.c., p. 138). Even the smallest specimens of upper molars recovered from the Duivelsklip block would make up an upper molar series of 6.8 mm, which is larger than that found in any *Oryzomys*. It is in the genus *Megalomys* that we find molars which are not only of the same structure but also of the same size as those from Curaçao dealt with in the present paper.

Megalomys, then, has a distinctly relict distribution in the Caribbean area; it has been found living only on Martinique and on Santa Lucia, and was exterminated around the beginning of the present century. The Martinique species is *Megalomys desmarestii* (Fischer); it is the largest species of its genus (greatest length of skull 7 cm, as recorded by TROUËSSART, 1885, p. 7). The Santa Lucia species is smaller; the skull length of *Megalomys luciae* (MAJOR, 1901, p. 206) is 49 mm. The only further record of *Megalomys* known to date is *Megalomys audreyae* HOPWOOD (1926) from Barbuda, based on a left ramus of the mandible with M_{2-3} in situ, found in a cave breccia presumably of Pleistocene age. The fossil Barbuda form seems smaller still than the Santa Lucia species, and is important as it shows the range of the genus ²) to have been more

¹) Both GOLDMAN (1918, p. 13) and GYLDENSTOLPE (1932, p. 31) refer to the development of a "paraconulid" in M_2 of *Oryzomys* and in its subgenus *Melanomys*, an element considered absent in *Nectomys*. The element in question is not a "paraconulid", a term neither mentioned by GOLDMAN in his list of crown elements (l.c., p. 11, copied by GYLDENSTOLPE, l.c., pl. xviii) nor indicated in the more detailed diagrams of WOOD & WILSON (1936) and HERSHKOVITZ (1944, p. 17 fig. 1). It is evident that the element in question is the "paraconid" of GOLDMAN, the anterior cingulum of our terminology, which may or may not be present in M_2 of *Oryzomys*, and is occasionally also discernible in M_2 of *Nectomys* (HERSHKOVITZ, 1944, p. 31 fig. 5a and b).

²) The genus *Megalomys* Trouessart, 1881, although believed to be not separable from *Oryzomys* by MAJOR (1901, p. 205), is considered a valid genus by ALLEN (1911, p. 179, 214-215), MILLER (1912, p. 178; 1924, p. 365), ANTHONY (1926, p. 211), HOPWOOD

extensive than it was at the beginning of European colonization of the Lesser Antilles.

The Leiden Museum is fortunate in having two skulls of *Megalomys*, one labelled "Iles Antilles" without further data (JENTINK, 1887, p. 219), and another originating from Martinique, which is one of the cotypes of *Megalomys desmarestii* (Fischer) presented by Mr. PLÉE and was received by exchange from the Paris Museum in 1825.

The dentitions of the two skulls of the Leiden Museum collection are larger than those of the fossil Curaçao species: the largest specimens recovered from the Duivelsklip block would make a series M^{1-3} 8.5 mm long, and an M_{1-3} 8.7 mm long (see table 7), whereas in the recent skulls the length M^{1-3} is 9.2–9.5 mm, and the length M_{1-3} 9.2–9.3 mm. The diameters of the incisors in the two skulls differ more than the diameters of the molars, as is shown in table 9.

TABLE 9
Measurements of incisors of recent and fossil *Megalomys*

	<i>M. desmarestii</i>	<i>M. audreyae</i>	<i>M. curazensis</i>
Upper I, anteroposterior	3.3–3.9	3.0	2.4–3.0
transverse	2.1–2.6	—	1.3–1.7
Lower I, anteroposterior	3.0–3.6	—	2.6–2.8
transverse	1.7–2.2	—	1.6

In *Megalomys luciae* the length M^{1-3} is given as 7.5 mm, that of M_{1-3} as 8 mm (MAJOR, 1901, p. 206). However, HOPWOOD (1926, p. 329) records the length M_{1-3} of *Megalomys luciae* as 9.4 mm, in which case there would be no difference in size between the Martinique and Santa Lucia species as far as the molars are concerned¹). Incisor diameters are not available for *Megalomys luciae*, but the measurements of the molar series as recorded by MAJOR are indicative of molars just as large as those in an average-sized dentition of *Megalomys curazensis* (see the diagnosis on p. 2–3).

Megalomys audreyae Hopwood, being known from an M_{2-3} (and an upper incisor included in table 9), excellently figured (HOPWOOD, 1926, pl. XII), can easily be compared with our fossil species from Curaçao. The length M_{2-3} is given as 5.2 mm (estimated length M_{1-3} , 8.3 mm); M_3 is slightly narrower and shorter than M_2 , and the crowns are low, as in our species. The mesostylids are well developed, and the "protoconulid" (anterolophid of our terminology, marked off by the minor fold)

(1926), TATE (1932, p. 10), ELLERMAN (1941, p. 359), ALLEN (1942, p. 90), SIMPSON (1945, p. 84), MILLER & KELLOGG (1955, p. 442), and A. E. WOOD (1955, p. 176). As has, however, been remarked by ELLERMAN (1941, p. 360) and by SIMPSON (1956, p. 11), *Megalomys* is very close to, and poorly differentiated from, *Oryzomys*. Generally speaking, mere size is not a good diagnostic character for genera, but, since the number of genera commonly recognized in Neotropical Hesperomyini is forty, I see no harm in retaining a distinct generic name for these interesting gigantic Caribbean island rats.

¹) Mr. R. W. HAYMAN kindly informs me (in litt., June 14th, 1957) that the alveolar lengths of the tooth rows of the type specimen of *Megalomys luciae* are actually as follows: M^{1-3} , 8.2 mm; M_{1-3} , 8.4 mm.

is slight. The "entostylid" (= posterior cingulum) is well developed in M_2 , and in both molars a posterior depression or "dimple" is seen in the hypoconid. In the Curaçao *Megalomys* the "dimples" are less strongly marked, especially that in M_3 . The ectostylids at the entrances to the major folds are also less strongly marked in the Curaçao than in the Barbuda molars. HOPWOOD (l.c., p. 329) remarks upon the apparent absence of "paraconids" (= anterior cingula) in *Megalomys audreyae*, and their presence in *Megalomys luciae*, but these anterior cingula greatly vary individually with the presence or obsolescence of the first secondary folds in M_{2-3} ; in *Megalomys curazensis* the first secondary folds of M_{2-3} are reduced or obsolete.

In conclusion, the fossil *Megalomys* teeth from Curaçao are only slightly different from those of Barbuda, which, in their turn, agree closely with those of the recently extinct Santa Lucia *Megalomys*. It is remarkable that the teeth of the (presumably) Pleistocene forms, occurring in the small islands of Barbuda and Curaçao, 1,000 km apart as the crow flies, should be so similar. It is unlikely that they should not have undergone specific or subspecific differentiation at least. In my opinion, therefore, the Curaçao *Megalomys* ought to be differently named, as I have done throughout the present paper.

Thomasomys spec. from Bonaire

The specimens described in the present chapter have been dressed from samples of a phosphatic "oölite" deposit collected at an escarpment near Fontein, Bonaire, by Dr. P. WAGENAAR HUMMELINCK in 1937. This deposit is very similar to that of Duivelsklip, Curaçao, yielding the *Megalomys* described above, but the fragments of fossil bone that it contains are larger: two mandibular fragments are over 14 mm long, and a cranial fragment is over 9 mm long, sizes only very exceptionally found among the fossil specimens from the Duivelsklip "oölite". On treatment with acetic acid, the Bonaire samples proved to contain a number of molars, all in situ in jaw fragments, which belong to a genus different from that from the Duivelsklip "oölite".

E 3399 is a portion of the left maxillary with M^{1-2} in situ. The external and posterior borders of the left incisive foramen are preserved; the incisive foramen terminates posteriorly just in front of M^1 . The median palatal suture is partially seen: the palate must have been at least as wide between the M^1 s as the combined width of right and left M^1 . The M^1 sin. is entire but very much worn down. The anterior surface of the anterocone is depressed in the middle, indicating the presence

of an anterior median fold. The anterocone is rather wide transversely, only slightly less so than the pairs of cusps behind. Because of advanced wear nothing of the anterior internal or anterior secondary folds has remained. The two primary folds and the first secondary fold are isolated from the external margin; the minor and major folds are still open internally. There is no trace left of the posterior cingulum. The crown measures 2.4 mm in length, and 2.0 mm in width. The M^2 of the same specimen is somewhat damaged externally, but the two primary folds likewise appear to be isolated from the margin. The first secondary fold is represented by two enamel islands. The minor fold is absent, and so is the posterior cingulum.

E 3400 is another portion of the palate with M^{1-2} sin. The M^1 is longer and narrower than that just described; it is only slightly worn (pl. III fig. 8). The crown is low, and has a broad anterocone, as in the foregoing specimen. There is a distinct anterior median fold that communicates with the anterior internal fold, dividing the anterocone into two conules of which the internal is the larger. The anterior secondary fold, although tiny, is present. The two primary folds are well developed; the internal portion of the second is isolated as a fossette. The first secondary fold is a transverse slit. The second secondary fold and the posterior cingulum are clearly visible. The length of the crown of M^1 is 2.6 mm, the width, 1.6 mm. M^2 of the same specimen is damaged at the base of the hypocone. The minor fold is much reduced, but is still visible in the early stage of wear of the specimen. The second primary fold is a continuous fold; the first appears to be bipartite, with its internal portion closed off. The second secondary fold and posterior cingulum are present, but would soon have been worn out. The crown of M^2 measures 2.3 by 1.5 mm.

There are three specimens of the anterior lower molar, one from the right side (E 3401) and two from the left side, E 3402-E 3403 (pl. III figs. 9-10). They are very similar in characters, except as regards one point: the M_1 dext. does not show an anterior median fold, while the other two do. In the more worn of the two left M_1 s this fold is quite distinct. On the occlusal surface of the anteroconid there are two enamel islets, the anterior internal and the anterior primary folds, respectively. The first secondary fold, marking off the anterior cingulum, is easily seen. The two primary folds, curving outward and forward as usual, are undivided. However, a peculiarity common to all specimens is that the entrance to the second secondary fold is quite conspicuous: a vertical groove extends to low down on the internal wall of the crown, and leads upward into the second secondary fold, so that there is a distinct incurvation of the internal marginal enamel just behind the first primary fold, marking off a strong mesostylid. This enamel infold is still visible when the primary folds are closed internally, and the external portion of the second secondary fold is isolated from the marginal part, as shown in the figures. The minor and major folds open widely on to the margin, and enterostyles are present. The dimensions of E 3401 and E 3403 are the same: length 2.6 mm, width 1.8 mm. E 3402 is slightly longer, and measures 2.8 by 1.8 mm.

E 3402 is in situ in a left ramus of the mandible, broken off anteriorly just in front of the mental foramen. The angle of the mandible, and the coronoid and condylar processes, are gone. However, the alveoli of M_{2-3} are shown: each molar has three roots, and the anterior root is duplicated. There is a pit between M_3 and the ascending ramus. The alveolar length of M_{1-3} is 6.7 mm.

Another fragment of the left mandibular ramus (E 3404) also shows the alveoli of M_{2-3} . The roots are the same in number: two anterior and one posterior to each molar.

E 3403 holds the lower incisor, 2.0 by 1.1 mm in diameter. A smaller specimen of lower incisor (E 3405) measures 1.8 by 0.8 mm in cross section. Two isolated upper incisors measure 2.4 by 1.2 mm in diameters (E 3405). There is no median anterior groove.

Apart from their smaller size the Bonaire molars differ from those of *Megalomys* in several structural details, as follows. The anterocone of M^1 is relatively wider; the anterior median fold is much more marked, and is continuous with the anterior internal fold in the slightly worn molar. The internal portions of the primary folds may be isolated from their external portions. In M_1 the anterior median fold, when present, is more distinct. The second secondary fold, as described above, has a lower and more pronounced entrance, with an enamel infold visible on the margin until late in the life of the tooth, and marking off a strong mesostylid. In the M_1 of *Oryzomys* and *Megalomys* the second secondary fold is already closed internally, without any infold of the marginal enamel showing, either earlier than, or at about the same time as, the primary folds. Finally, in *Oryzomys* (GOLDMAN, 1918, p. 12) there are only two roots to M_2 and M_3 , one anterior and one posterior.

It seems clear that the present specimens could not belong to *Oryzomys*, or to any oryzomyine rodent, for that matter. *Nectomys* need not concern us, because of its much higher crowns, and because in *Nectomys* the second secondary fold in M_1 is closed off internally by the fusion of the mesostylid with the entoconid (HERSHKOVITZ, 1944, p. 19).

The Bonaire molars described above have the greatest resemblance to a genus of Hesperomyini named *Delomys* by THOMAS. A specimen of the genotype, *Hesperomys dorsalis* Hensel, has been excellently figured by HENSEL (1873, pl. II fig. 16a, b)¹, and it shows all the most distinctive characters: the anterior median fold, wide anterocone, and strong mesostylid. As remarked by GYLDENSTOLPE (1932, p. 60), the molars of *Delomys* are brachyodont, rather narrow but *Oryzomys*-like in structure, and M^1 is of an evenly oblong shape.

Delomys is at present included in the genus *Thomasomys* Coues, 1884 (ELLERMAN, 1941, p. 366; SIMPSON, 1945, p. 84), the dental description of which genus in GYLDENSTOLPE (1932, p. 51) is identical with that of *Delomys* given by this author. The species of *Thomasomys* listed by GYLDENSTOLPE (l.c., p. 141) vary in length M^1-3 from 3.5 to 7.6 mm, a range that would include the Bonaire form.

The genus *Thomasomys* as now understood comprises fifty-one species the geographical range of which covers British Guiana, Venezuela, Colombia, Ecuador, Peru, Bolivia, northern Argentina, and south-eastern Brazil (ELLERMAN, 1941, p. 367). The present fossil specimens indicate that its range once also included at least one of the Caribbean islands.

Beside the *Oryzomys* and *Megalomys* already mentioned above, one more form of Hesperomyini is known to occur in the Caribbean islands, viz., *Hesperomys*? spec. on Aruba (WAGENAAR HUMME-

¹) For another good figure, see SCHAUB, 1925, pl. V figs. 8, 10.

LINCK, 1940, p. 69); if the generic allocation proves to be correct this occurrence would be an even greater surprise than the discovery of *Thomasomys* on Bonaire, for at present *Hesperomys* is not known to occur anywhere north of Peru (ELLERMAN, 1941, p. 446).

Pending a full revision of the genus *Thomasomys*, in which more attention should be given to the teeth than is commonly paid to the dentition in neozoological descriptions, the Bonaire fossil rat may be recorded simply as *Thomasomys* spec.

It is highly desirable that the phosphate and "oölite" deposits of Bonaire and Curaçao, and other similar deposits known to be present in the Caribbean islands, should be searched for animal remains. The finds reported upon in the present paper lead one to believe that, in these deposits, remains of many more interesting animals, either no longer living on the islands or entirely extinct, await discovery and identification.

Hydrochoerus hydrochaeris (L.) from Curaçao

The fossil remains dealt with below were found in a reddish-brown phosphatic "oölite" collected at the Tafelberg Santa Barbara, eastern Curaçao, at a height of about 160 m above sea-level. The matrix was less workable by the acid method than that of Duivelsklip, and the specimens had to be prepared mechanically. Remains of three teeth are available, for the greater part still embedded in the matrix, viz., an M^3 dext., a P_4 sin., and an M_3 dext. In addition, a number of incisor fragments have been found. The specimens, being softer than the surrounding matrix, have suffered badly from the mechanical treatment, but they are readily identifiable: they belong to the living species of *Hydrochoerus*, *H. hydrochaeris* (L.).

The best specimen available is an upper last molar, the largest tooth of the series (E 3413). The occlusal surface, seen in profile in the matrix, is perfectly flat and entire from front to back; the tooth was evidently embedded whole. At the anterior end the V-shaped lobe with the deep outer fold is well exposed. The V-shaped lobe at the posterior end, with the fold internally, is also seen. Between the two terminal lobes there are ten transverse plates, and the overall length of the crown is 27 mm. The width of the crown cannot be given because of the poor state of preservation of the specimen.

The left lower premolar shown in another fragment of the matrix (E 3414) consists of three lobes, each with an inner fold; the anterior lobe is incomplete in front. The junction of the anterior wing of the posterior lobe to the posterior

wing of the middle lobe is just external to the median line of the crown, and the anterior wing of the middle lobe is joined internally to the posterior wing of the anterior lobe. Unfortunately, the anterior loop of the front wing is gone.

The right lower last molar (E 3415) is likewise incompletely preserved, but the occlusal surface partially exposed shows the posterior lobe, which consists of two narrow transverse plates joined internally; two more plates somewhat thicker anteroposteriorly; and the anterior lobe, the front plate of which is, again, narrow. The junction of the two anterior plates is not shown; the exact length of the worn surface cannot be given.

Several portions of molars are also embedded in the rock (E 3416–E 3418 and E 3423), but these are too small for their serial position to be determined. There are a number of fragments of incisors (E 3419–E 3422); one of them, which is exposed for a length of 4 cm and, judging by its slight curvature, is evidently from the lower jaw, left side, measures 7 mm transversely, and 6 mm anteroposteriorly in cross section. The cross section is triangular with rounded angles; only the front surface is coated with enamel, and it is ungrooved.

Bone fragments abound in places throughout the matrix, but, except for parts of an ilium and of an astragalus, nothing can be identified with certainty (E 3424–E 3440, E 4330).

I have compared the above-mentioned remains with twenty skulls of *Hydrochoerus hydrochaeris* (L.) in the Leiden Museum. If the series is arranged according to increasing basilar length (basion-prosthion), it also shows an increase in length of the occlusal surfaces of the teeth. The diameters of the extremely hypsodont premolars and molars increase slowly to their bases, enabling the occlusal surfaces to keep pace with the growing skull (table 10). It should be emphasized that P4 and M3 are in place, and in use, in all the skulls examined. The smallest skull of my series corresponds in size with a juvenile skull figured by MÜLLER (1933, figs. 6d, 8d); the basilar length of a neonatus skull (MÜLLER, l.c., figs. 6b, 8b) is ca. 55 mm.

M³ varies in length from 18 to 43 mm; the number of plates between the terminal lobes is 9 or 10. The posterior end of M³ varies somewhat in that the two plates constituting the hind lobe may not be connected externally, and in the width of the

TABLE 10
Measurements of skulls of recent *Hydrochoerus*

Leiden Museum, reg. nos.	Basilar length	Length M ³	Leiden Museum, reg. nos.	Basilar length	Length M ³
2516	93	18	2215	176	35
cat. f	ca. 105	20	3812	178	34
10905	124	27	3467	182	35
2224	128	24	cat. b	182	38
cat. a	134	27	1317	196	37
3479	150	28	2276	200	38
2041	158	32	cat. g	212	42
3744	172	33	cat. c	215	43
1704	173	34	cat. d	216	39
cat. e	ca. 175	36	803	219	41

hindmost wing, which may be incipient to full-sized, but is generally distinctly narrower than the anterior wing of the hind lobe.

The fossil specimen of M^3 corresponds in size with that shown in recent skulls with a basilar length of around 130 mm, a stage of growth in which the skull is only about two-thirds as large in linear dimensions, and the crown surfaces of the molars are about one-half as large, as they are in full-grown animals.

Both the P_4 and the M_3 , though incomplete anteriorly, compare very well in the matter of size and proportions with their homologues in the small skulls (especially the fourth and fifth of the series), and evidently belonged to individuals in the same stage of growth as that of the M^3 . The incisor also agrees in size with the lower I in the small skulls in question, which measure 6.7–7.0 mm transversely, and 5.4–5.9 mm anteroposteriorly, in section. The median longitudinal groove is only very slightly marked in the front surface of the young incisor; as has been said above, it is apparently absent in the fossil specimen, but of this specimen only a very small portion of the front surface is exposed.

In the absence of other remains that can definitely be ascribed to *Hydrochoerus hydrochaeris* ¹⁾, it seems likely that what we have found in the block of "öolite" from the Tafelberg Santa Barbara are the remains of a single individual, an individual the basilar length of whose skull was about 130 mm.

The recent capybara is known to occur in the Guiana lowlands wherever there are large enough streams with sufficient succulent vegetation (TATE, 1939, p. 186); it ranges northward into Panama (MILLER & KELLOGG, 1955, p. 635), and southward to Peru (SANBORN, 1951, p. 23) and south-eastern Brazil. In the Pleistocene it also occurred in North America, but the Pleistocene forms from Florida, Texas, and South Carolina (HAY, 1926; SIMPSON, 1928, 1930) are in part considerably larger than the living *Hydrochoerus* and have been referred to a distinct genus: *Nechoerus*. As remarked by KRAGLIEVICH (1930, p. 246) none of the fossil North American forms is directly ancestral to the recent form, which doubtless evolved in South America.

South American fossil hydrochoerines are currently referred to a number of distinct genera reviewed by KRAGLIEVICH (1930). However, as stated by RUSCONI (1939, p. 233), the fossil material does not permit of a phylogeny to be established; the available evidence would point to a polyphyletic rise of the carpinchos. However this

¹⁾ Two enamel-coated surfaces, about 5.5 mm in width and only 2 cm long, are too straight for incisors and may have formed part of molars.

may be, the fossil remains of *Hydrochoerus* from Curaçao recorded above are indistinguishable from the living species. This is the first record of the species from the Caribbean islands, no specimens having been reported from either the Greater or the Lesser Antilles.

It should be borne in mind, however, that the remains of *Hydrochoerus hydrochaeris* (L.) are most probably derived from a single juvenile individual. Although, as observed by DARWIN (1889, p. 36), capybaras "occasionally frequent the islands in the mouth of the Plata, where the water is quite salt", it seems too much to suppose the animal to have swum across. Curaçao is 64 km from the Peninsula of Paraguaná. Moreover, the fact that the lower and the upper teeth were found close together in the block of matrix militates against the supposition that the carcass floated all the way from the Venezuelan coast, for during such a long period in the water the lower jaw would have become detached from the calvarium, and the teeth would have fallen out. Mr. DE BUISSONJÉ tells me that, in any case, the cliff may have been too high above sea-level for the animal to have been deposited by the ocean waves even during a storm.

Therefore, if the individual to which the teeth belonged did not arrive alive on a natural raft, transportation by human agency is the most probable interpretation. However, we know neither the time of the first human settlement of Curaçao, nor the time of formation of the *Hydrochoerus*-bearing deposit.

If the fossilized *Hydrochoerus* teeth are accepted as having belonged to a single individual that somehow accidentally got transported out to sea from the Venezuelan coast, either by flotsam-jetsam methods or by native boats, we do not have to believe that the capybara, an animal so partial to water, was able to establish itself on semi-arid Curaçao and persist there for any length of time. As long as no further evidence of the former existence of the capybara in Curaçao is available I do not think we are justified in considering *Hydrochoerus hydrochaeris* (L.) as belonging to the endemic fauna of that island.

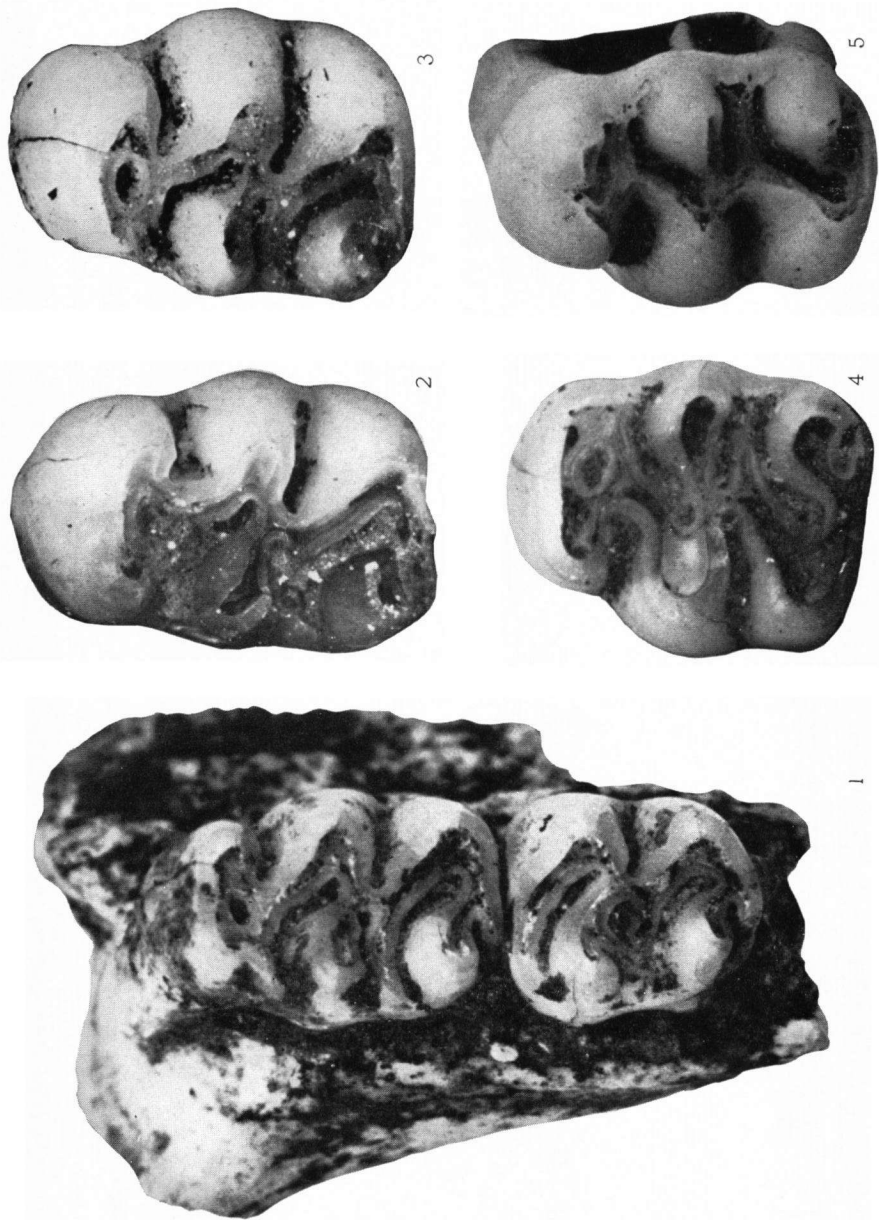
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PLATE I



Megalomys curazensis nov. spec. from Duivelsklip, Curaçao, Curacao, crown views: fig. 1, M1-2 dext. (holotype) E 3187; fig. 2, M1 dext. E 3189; fig. 3, M1 dext. E 3188; fig. 4, M1 sin. E 3205; fig. 5, M1 sin. E 3204. — All figures $\times 15$.

PLATE II



Figs. 1-9, *Megalomys curazensis* nov. spec. from Duivelsklip, Curaçao, crown views: fig. 1, M² dext. E 3221; fig. 2, M² sin. E 3236; fig. 3, M³ dext. E 3246; fig. 4, M³ dext. E 3247; fig. 5, M³ sin. E 3262; fig. 6, M¹ dext. E 3271; fig. 7, M¹ sin. E 3283; fig. 8, M¹ sin. E 3285; fig. 9, M¹ sin. E 3284. — Fig. 10, *Oryzomys* spec. from Cave of Hato, Curaçao, M³ sin., crown view. — All figures $\times 15$.

PLATE III

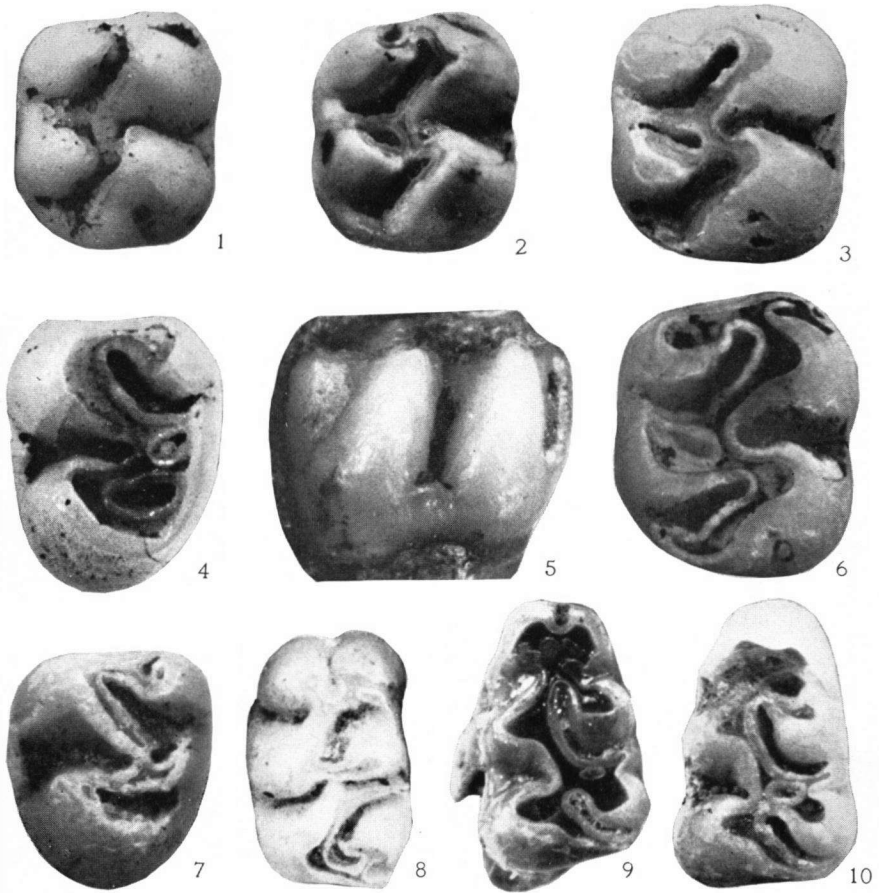


Fig. 1-7, *Megalomys curazensis* nov. spec. from Duivelsklip, Curaçao, all, except fig. 5, crown views: fig. 1, M_2 dext. E 3289; fig. 2, M_2 dext. E 3290; fig. 3, M_2 dext. E 3291; fig. 4, M_3 sin. E 3341; fig. 5, M_2 dext. E 3293, external view; fig. 6, M_2 dext. E 3292; fig. 7, M_3 sin. E 3343. — Figs. 8-10, *Thomasomys* spec. from Fontein, Bonaire, crown views: fig. 8, M_1 sin. E 3400; fig. 9, M_1 sin. E 3402; fig. 10, M_1 sin. E 3403. — All figures $\times 15$.