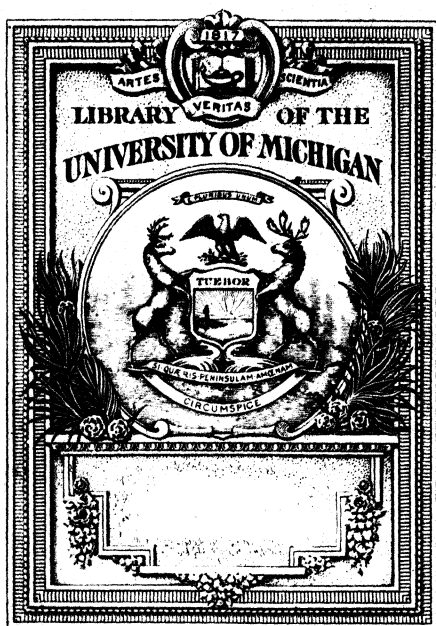


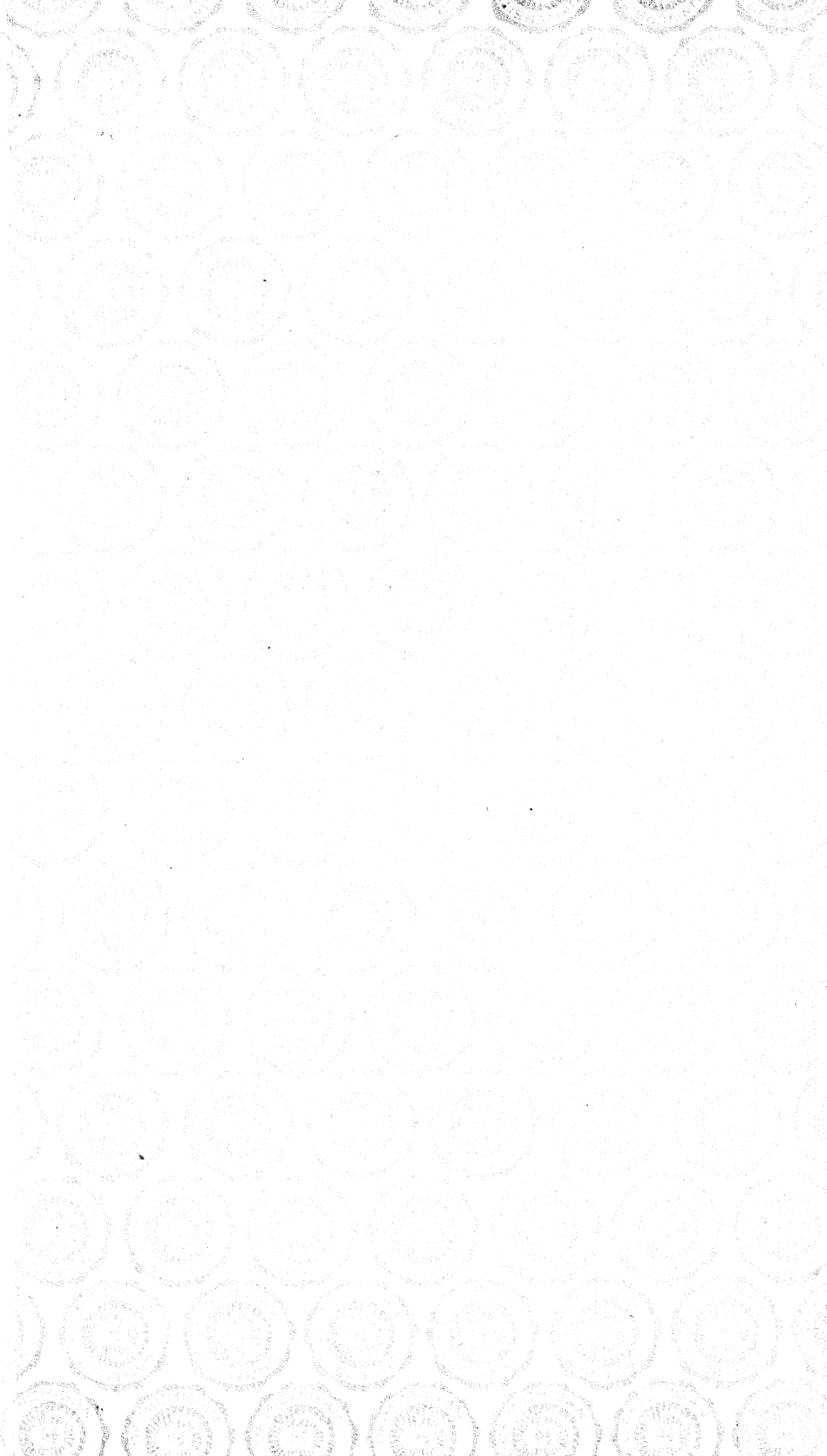
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Mammals of Porto Rico, Living and Extinct—Chiroptera
and Insectivora—*H. E. Anthony*



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MAMMALS OF PORTO RICO, LIVING AND EXTINCT

By H. E. ANTHONY

CHIROPTERA AND INSECTIVORA

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INTRODUCTION

Plans for a natural history survey of the Island of Porto Rico were drawn up in 1913 by the New York Academy of Sciences, with the active coöperation of the Insular Government of Porto Rico, The American Museum of Natural History, the New York Botanical Garden, and Columbia University. The plans covered work in all the different departments of Zoölogy, Botany and Geology. The first field work was begun in 1914 and the author was given the assignment to report upon the mammals of Porto Rico.

At the time this survey was planned, the known mammal life of Porto Rico was exclusively a bat fauna, no terrestrial land mammals other than introduced species being known from the island. The investigations of the anthropologists under Dr. Franz Boas, in 1915, gave promise of most interesting and unexpected additions to the list of mammals. In excavating shell-heaps, and caves formerly occupied by the aborigines, they discovered fossil remains of three undescribed rodents and a new ground-sloth. This evidence of a fossil mammal fauna greatly stimulated interest in what had promised to be a rather narrow field of research. Active field work for mammals was begun in May, 1916, and the author was able to further increase the list of terrestrial mammals and secured a great abundance of fossil material, as well as fairly extensive collections of the bat fauna.

The author was accompanied throughout the field work in Porto Rico by his wife, the late Edith I. Anthony, who was an active assistant during this time and found many of the specimens brought back by the expedition.

ITINERARY

Text Fig. 1

We arrived at the port of San Juan May 31, 1916. The day was devoted to visiting the Government officials and arranging the various

details of field work. Our first move took us to San German, near the west coast of the island, where we met Dr. Spinden, of the American Museum Department of Anthropology. Coöperative investigations were carried on for several days with the expectation of finding mammal remains in Indian shell-heaps and kitchen-middens. Although search was extended as far as Cabo Rojo, this immediate region did not yield very promising results and it was necessary to move on to Adjuntas. Both at San German and Adjuntas no opportunity was overlooked to collect specimens of the living mammals, namely, the bats. The third site selected was Utuado, in the interior of the island, and from this region we secured some of our most important material. Owing to the terrible condition of the trails and to a lack of understanding on the part of the natives, great difficulty was experienced at first in locating caves and favorable spots for excavation. Eventually an abundance of fossil mammal material was secured from caves which were worked from Utuado as a base. Several side trips were made while we were located at Utuado, one of these being to the Hacienda Jobo and another to Quebradillas. Dr. Spinden, finishing his archæological investigations while we were at Utuado, returned to San Juan and to New York.

Upon completing the region about Utuado, it was necessary to return for a stay of several days at San Juan, and during this time, July 3 to July 8, several important caves in the San Juan vicinity were worked. One of these caves is the type locality for two species of bats. It is of interest to note that bats were more abundant and representatives of more species were collected about the San Juan sector than anywhere else on the island. Leaving San Juan, we returned to Utuado to pick up fossils which had been excavated on contract, and passed on west to Lares. Not very much was added by the visit to Lares, which seemed to be a region of rather limited possibilities, although there is an interesting deposit of fossil-bearing Tertiary limestones near San Sebastian. A delay in the receipt of funds expected from San Juan made necessary a return again to that site, and, as before, while waiting there, more of the caves of the region were visited.

We then motored to Manati, and a very promising field for fossil mammals was located near Morovis. It was possible to work out from Manati as a base, and several caves near Morovis yielded a great abundance of mammal remains. On July 21 we returned to San Juan, and then went eastward to investigate the high mountainous area about El Yunque. Our headquarters were established at the Preston ranch, near Naguabo, where we were most hospitably received by the overseer. Unfortunately, no very extended work could be carried on here because of continuous, heavy rains. A long, all-day tramp back toward the summit of El

Yunque convinced me of the uselessness of any work in that region during the short time at our disposal and the probable negative results as far as mammals were concerned. From the Preston ranch our route took us to Coamo by the road which parallels the coast, and from Coamo we went inland as far as Cayey. The next move brought us to Ponce, where we left the automobile, took train and went around the coast, stopping off at Manati once more in order to run down several clues which we had been unable to investigate on the former visit. This completed the field work, the collecting at Manati being the last. On August 2 we left San Juan for New York.

So far as was possible in the limited time available for the work, special efforts were made to investigate each distinct type of country and each different ecological area. In a general way the entire island was covered, and although many regions were passed by, it was felt that work in these places would serve only to duplicate results obtained elsewhere.

PREVIOUS WORK ON THE MAMMALS OF PORTO RICO

The first work on the mammals of Porto Rico was done by Dr. Juan Gundlach, who made three trips to the island from Cuba, in 1873, 1875 and 1881. The principal localities worked by Gundlach were Aguadilla, Guanica, Lares, Utuado, Arecibo, Quebradillas, Vega Baja and Bayamon. The results of the first two trips appeared in the *Anales de la Sociedad Española de Historia Natural* for 1878. The part devoted to mammals is not very extensive and occupies only three pages; four species of bats comprised the known indigenous mammalia. Other collectors did work on the island at various times, but the total results have not greatly enlarged the knowledge of Porto Rican mammals, partly through non-publication. Mr. Alex. Wetmore, of the United States Biological Survey, worked in Porto Rico from December, 1911, to September, 1912, primarily on the birds of the island, but incidentally secured a fine collection of the bats, 235 specimens, among them a new form of *Eptesicus*. The Museum of Comparative Zoölogy sent an expedition under Dr. G. M. Allen to Porto Rico in the spring of 1917, a small collection of bats and fossil mammals being secured, none of which proved to be new.

SPECIMENS RECEIVED FROM PORTO RICO SUBSEQUENT TO THE NEW YORK ACADEMY EXPEDITION OF 1916

Important collections of fossil mammal remains have been made by Señor R. Fernandez Maceira, of Rio Piedras, Porto Rico, who apparently found the bones while digging in caves for fertilizer. Señor Maceira has carefully saved all bones found in this manner and since 1920 has for-

warded three lots to the American Museum. The first collection, which was the largest, and the third collection were purchased by the American Museum and the second collection was acquired by the Museum of Comparative Zoölogy. The lots purchased by the American Museum are exclusively ground-sloth bones and it will be possible to mount a composite skeleton of this animal from the material.

Señor Maceira writes that these ground-sloth bones all came from the same cave, at Cabachuelas, Barrio de las Torrecillas, near Morovis. The place goes under the local name of Cerro Hueco. It is a large cave, about sixty-five meters long by forty-eight wide. The bones were found at a depth of seven or eight meters.

ACKNOWLEDGMENTS

It is a pleasure to acknowledge the wide-spread interest in the Porto Rican work and the great help and assistance which has been given me by different institutions and individuals. Dr. H. E. Crampton, of the Porto Rican committee of the New York Academy of Sciences, has done everything to make the work successful. The officials of the Insular Government, Governor Yager, the auditor, Judge Bonner, and the Chief of the Insular Police, Colonel Shanton, assured the success of the field work by their coöperation. The insular police were always eager to render very capable assistance wherever I found it necessary to call upon them. To the late Basil Hicks Dutcher, then a Major of the U. S. A. and surgeon for the insular troops, I owe a debt of gratitude, as does each one of the Academy field workers in Porto Rico, who found him a close friend. The residents of Porto Rico I found always interested and helpful, and I wish to acknowledge especially the coöperation in my work given by Mr. Leopoldo Strube, of Utuado. Mr. Gerrit S. Miller, Jr., of the United States National Museum, has been very generous in the matter of loans of West Indian bats and other material. Mr. Alex. Wetmore, of the United States Biological Survey, kindly allowed me the use of his bat records from Porto Rico. Dr. G. M. Allen, of the Museum of Comparative Zoölogy, and Dr. Witmer Stone, of the Philadelphia Academy of Sciences, have also assisted by the loan of needed material.

The late Dr. J. A. Allen, Curator of the Department of Mammals in the American Museum, gave me the great benefit of his long experience in numerous consultations, both on the systematic work of the report and on editorial matters. Dr. W. D. Matthew, Curator of Vertebrate Paleontology of the American Museum, and Mr. Walter Granger, of the same department, have assisted me in many ways, not only by contribution of departmental aid but by consultation as well. The Director of

the American Museum, Dr. F. A. Lucas, showed his sympathy and interest in the enterprise and did all that he could to further the work.

Finally, this list would not be complete without an expression of gratitude to my wife, the late Edith I. Anthony, who from the beginning took an active hand in the collection of material and its preparation, the writing of notes, the copying and arranging of the manuscript, the figures and the bibliography.

The text figures, with but few exceptions, were made by Mrs. Helen von Ziska, under my supervision. The bones figured were first outlined by means of the camera lucida and then the proportions checked by dividers. In connection with the text figures, I am greatly indebted to Mr. James P. Chapin, at that time a co-worker in the same department with me, for the benefit of much advice and help.

All of the typing and work of a secretarial nature has been done by Miss Ida Grobe, of the department staff, who has been exceedingly helpful to me in the preparation of this report, and whose name should not be omitted from this list of acknowledgments.

The color terms used in the descriptions are taken from Ridgway, *Color Standards and Nomenclature*, 1912.

I have constantly consulted *The Families and Genera of Bats*, by Gerrit S. Miller, Jr. (U. S. National Museum, Bull. 57, 1907), and helped myself liberally to the data therein when giving the characterizations of the bats, because I know of no more authoritative source than this invaluable report. In many cases it may be noted that my descriptions are but slightly altered transcriptions of Miller's wording.

PHYSIOGRAPHY

Plates I-IX

Porto Rico is a small island, 95 miles in length by 35 miles in breadth, with an area of 3,668 square miles. In shape it approximates a parallelogram, the sides of which run in the cardinal directions of the compass. The island is divided by physiographic features into several very distinct ecological areas. Mountain ranges of fair elevation extend east and west for the full length of the island, reaching in the western part an elevation of nearly 4000 feet and culminating at the eastern end in El Yunque, of 4985 feet elevation. These ranges form the backbone of the island and the greater part of its area as well. A large part of the northwestern end of the island is limestone, which occurs as a layer of considerable thickness. The southwestern part of the island also contains limestone, but it is here widely scattered. The eastern end of the island consists of conglomerates and metamorphic rock.

On parts of the island the annual rainfall is very heavy, notably in the high mountains at the eastern end and throughout the mountain district in general. On the southwestern end the rainfall is very scanty and desert conditions prevail. There are several good-sized rivers, the largest flowing through valleys of considerable extent. Throughout most of the island the virgin forest has been destroyed to make way for plantations, but in a few isolated localities remnants of the early forest remain. Such places may be found about Maricao, Utuado, and to the greatest extent in the Luquillo region. Close attention was paid to changes in the ecology of the country traversed, in the hope of finding changes in the bat fauna, but none were noted; although, because of the short time spent in the arid southwestern region, the most likely field for such observations was not by any means exhausted.

LIST OF CAVES WHERE MATERIAL WAS COLLECTED

Plates X-XII

- | | |
|------------------|---|
| San German— | Cave of Monte Grande.
Two caves at Peños Lejos.
One unnamed cave.
Only bats and a very few scraps of <i>Isolobodon</i> secured at San German. |
| Cabo Rojo— | Shell-mounds only; fragments of <i>Isolobodon</i> . |
| Utuado— | Fourteen caves located at varying distances from the town. Many of these caves are unnamed, but a few have local designations.
Caves of Caguana.
Cueva de los Golondrinos.
Cueva de la Ceiba, on Hacienda Jobo.
Cave on property of Don Gervacio Toraño—an important cave for fossils.
Cave on property of Don Sexto Lago. |
| San Juan Region— | Cueva de Fari, near Pueblo Viejo—important for bats.
Cueva de Trujillo Alto—a good bat cave.
Piedra de la Cueva, Old Loiza, home of <i>Noctilio</i> . |
| Quebradillas— | Two nameless caves. |
| Lares— | Cueva de Pajita. |
| Corozal— | Cueva de Corozal—a bat cave. |
| Morovis— | Thirteen caves visited, eight of them nameless.
Cueva Lucera.
Cueva de Achatillo.
Cueva de San Miguel.
Cueva Clara—an important cave.
Cueva de Catedral—an important cave. |
| Cayey— | An unnamed cave with many bats. |

To summarize results, it might be stated that the Utuado and the Morovis regions were by all odds the richest in fossil-bearing caves. Bats were most abundant and varied in species in the San Juan region. In all, some 54 caves were explored.

LIST OF INDIGENOUS LAND MAMMALS OF PORTO RICO

LIVING	FOSSIL
Chiroptera	Chiroptera
<i>Noctilio leporinus mastivus</i>	<i>Monophyllus frater</i>
<i>Chilonycteris parnellii portoricensis</i>	<i>Stenoderma rufus</i>
<i>Chilonycteris fuliginosa inflata</i>	<i>Phyllonycteris major</i>
* <i>Mormoops blainvillii</i>	Insectivora
* <i>Monophyllus portoricensis</i>	<i>Nesophontes edithae</i>
* <i>Brachyphylla cavernarum</i>	Rodentia
<i>Artibeus jamaicensis jamaicensis</i>	<i>Isolobodon portoricensis</i>
<i>Erophylla bombifrons</i>	<i>Elasmodontomys obliquus</i>
* <i>Eptesicus fuscus wetmorei</i>	<i>Heptarodon bidens</i>
<i>Tadarida murina</i>	<i>Heteropsomys insulans</i>
<i>Molossus fortis</i>	<i>Homopsomys antillensis</i>
	Edentata
	<i>Acratocnus odontrigonus</i>
	<i>Acratocnus major</i>

PROBABLE AGE OF THE FOSSILS

A conservative estimate of the age of the fossil species of Porto Rico would place them in the Pleistocene and probably late Pleistocene. Indeed, it is more than probable that some of this fauna persisted into the Recent. *Isolobodon* we have found in the shell-heaps and know that it was an article of diet among the Arawaks. Many of the bones of the other species have every appearance of being fairly recent, geologically speaking. The evidence would indicate that the fossil species taken were all contemporaneous, since they occur in the same formation in nearly every instance. A possible exception is *Isolobodon*, which was doubtless the last mammal to become extinct on the island.

The fossil remains were encountered at depths of a few inches from the top down to as deep as nine feet. Often but little scraping was necessary to uncover bones, although in this connection it is well to state that the natives of the island are in the habit of digging out the bat guano from the caves and frequently take the earth from the floor of the caves as fertilizer. Thus the height of the earth in any cave may not always be considered with certainty as the maximum height of the deposit. However, the height of the original deposit is generally betrayed

* Also found fossil.

by a discolored ring around the walls of the cave. The bones were very fresh in appearance when excavated and had not undergone any mineralization. In the case of the bats found fossil in the Cueva Catedral, a number of skulls were collected that prove indistinguishable from the living bats, and this formation contained the insectivore *Nesophontes* as well.

Fossils collected in Cuba and in Jamaica under similar conditions display unmistakable evidence of recent deposit.

As a general rule, the specimens were found in dry limestone caves in the mountainous part of the island. Caves on the sides of small hills yielded the most bones, and the size of the cave was immaterial. The cave that contained the greatest amount of ground-sloth material was a small one, with the entrance on a rather steep hillside and opening out of a sheer front of limestone. Inside, the cave did not open out very wide, but had a deep fissure at the left toward which the floor sloped abruptly. This fissure was richly packed with bones of the sloth and the large rodent *Elasmodontomys*, the bones beginning at near the surface and continuing down some nine feet, when excavations had to be given up because of the impossibility of reaching any deeper. This cave had the appearance of a trap for any animal that wandered into it and certainly would have proved so for any old or sick animal that had strength enough to crawl up through the cave entrance. The earth in this cave, which is the one on the property of Don Gervacio Torano near Utuado, is reddish in color and composed completely of disintegrated limestone. It is rather coarse in texture and intermingled with it were good-sized fragments of the walls.

A much different type of cave is the Cueva Catedral, near Morovis. Also situated on a steep hillside, it occupies the top of a small hill, and the ceiling of the cave has fallen through, letting in considerable light. This cave has two large entrances and is a large, open chamber filled to a depth of several feet with earth and many fallen fragments of limestone. At one side there is a deep deposit of fine powdery soil, almost pure bat guano in spots, sloping rather steeply down from the back wall of the cave. The natives have removed from this part of the cave a great deal of the rich soil for fertilizer. Throughout a stratum of several inches to a foot or more in thickness, this deposit was literally packed with small bones of mammals, birds, reptiles and amphibians. In some spots the bones were interlaced almost in hundreds and a quart of earth required some minutes to pick over. In the crevices between the larger blocks of limestone and in the irregularities in the cave floor were especially rich pockets of these bones. Farther up the slope, above the fine

earth, a large number of skulls, some of them lime-encrusted, were found beneath a heavy, flat slab of limestone.

Subsequent cave explorations in Cuba and Jamaica have indicated that owls are to be considered responsible for these large aggregations of bones of the smaller creatures. The owls spend the day in the caves, where they cast up in pellets the bones of animals small enough to be swallowed, and may carry to their perch there the larger species which must be eaten piecemeal. A cave which is thus the home of owls may, over a period of hundreds or thousands of years, accumulate an almost unbelievable amount of bones, to be judged in hundredweights or even tons in some cases. While the large barn-owl known in Cuba and Jamaica today is absent from Porto Rico, Dr. Wetmore has discovered the fossil remains of a barn-owl among bird bones collected by me at Utuado, while the small bare-legged owl is common on the island today and probably should be considered as a factor in the creation of these cave deposits. (Wetmore, 1922, pp. 299 and 323.)

Isolobodon was found on the very surface of the floor, in nearly every case, in caves which had been occupied by the former Indian inhabitants of the island. Designs upon the walls of the cave, broken pottery and ashes attested to the occupancy, and amidst the ashes and fragments of pottery the scattered bones of this rodent could be found. Also throughout the great shell-heaps along the coast, especially at Cabo Rojo, an occasional bone of *Isolobodon* was encountered.

It is likely that the Arawaks or the Caribs carried *Isolobodon* with them in their canoes as food, since the remains of this rodent have been found on the eastern end of Santo Domingo and in the Virgin Islands associated with human artifacts. Wetmore (1922, p. 300) heard stories of the natives which hint at the persistence of *Isolobodon* into quite recent times.

Order CHIROPTERA

Suborder MICROCHIROPTERA

The first authentic list of the bats of Porto Rico was published in 1878, a paper by Gundlach in the *Anales de la Sociedad Española de Historia Natural*, 1878. He listed only four species, *Artibeus perspicillatus*, *Mormoops blainvillii*, *Chilonycteris macleanii*, and *Molossus obscurus*. Later lists have all accredited three of these species to Porto Rico, but for some reason have omitted his record for the genus *Mormoops*. Subsequent papers have added to the Porto Rican fauna, six species and subspecies being given by Dr. G. M. Allen in his *Mammals of the West Indies*, published in July, 1911, in addition to several other subspecies

given as doubtful records. The first mention of any native mammal from Porto Rico not a bat is the description of *Isolobodon portoricensis* by Dr. J. A. Allen (1916, p. 19). Fourteen species and subspecies of bats, four of them new to the island, were given in a paper published on the *Indigenous Land Mammals of Porto Rico* by Anthony (1918). No species have been added since this time.

Four families of bats are represented on the island: the Noctilionidae with one species, the Phyllostomidae with ten species, the Vespertilionidae with one species, and the Molossidae with two species. Porto Rico has several endemic species and several genera endemic to the West Indies. These endemic forms are found only in the family Phyllostomidae. The species of the other three families all have very near relatives on the continent or possibly occur there as the same species. No less than five genera of the Phyllostomidae of Porto Rico are endemic to the West Indies. The following list of the bats of Porto Rico will indicate this relationship:

Family NOCTILIONIDAE

Noctilio leporinus mastivus..... continental species

Family PHYLLOSTOMIDAE

Chilonycteris fuliginosa inflata.. species endemic to the West Indies

Chilonycteris parnellii portori-

censis species endemic to the West Indies

Mormoops blainvillii..... species endemic to the West Indies

Monophyllus portoricensis..... genus endemic to the West Indies

**Monophyllus frater*..... genus endemic to the West Indies

Brachyphylla cavernarum..... genus endemic to the West Indies

**Stenoderma rufus*..... genus endemic to the West Indies

Artibeus jamaicensis jamaicensis. continental species

**Phyllonycteris major*..... genus endemic to the West Indies

Erophylla bombifrons..... genus endemic to the West Indies

Family VESPERTILIONIDAE

Eptesicus fuscus wetmorei..... continental species

Family MOLOSSIDAE

Tadarida murina..... species endemic to the West Indies

Molossus fortis..... species endemic to the West Indies

The endemic nature of the bat fauna is readily apparent and is good evidence of the long continued separation of Porto Rico from any mainland connection, since it is well known that bats are subject to practically the same laws of dispersal as are terrestrial mammals. (Dobson, 1878,

* Found fossil only.

pp. 158-167; G. M. Allen, 1911, pp. 175-176; Andersen, 1912, pp. lxxvi-lxxvii.)

Family NOCTILIONIDAE

See Miller, The Families and Genera of Bats, p. 95, 1907, for diagnosis of the family; p. 97 for diagnosis of the genus.

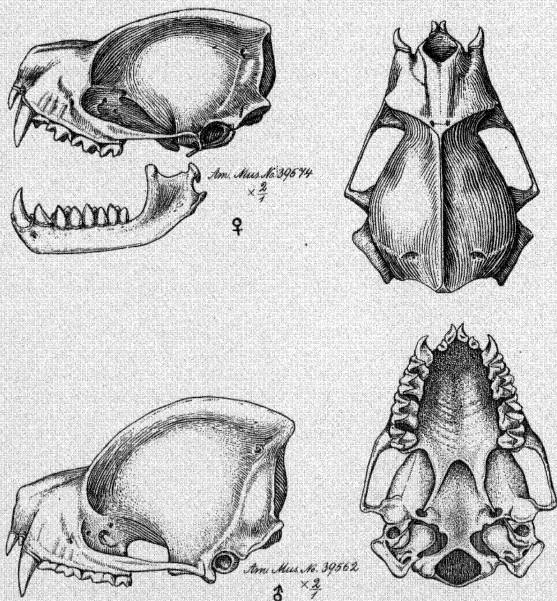


FIG. 2.—*Noctilio leporinus mastivus* $\times 2/1$; Old Loiza, Porto Rico

Noctilio leporinus mastivus (Dahl)

Text Fig. 2

1797. *Vespertilio mustivus* Dahl. Skrifter af Naturhist.-Selskabet, Kjöbenhavn, IV, p. 132.

1885. *Noctilio leporinus mastivus* True, Proc. U. S. Nat. Mus., VII (1884), p. 603.
1911. *Noctilio leporinus* G. M. Allen, Bull. Mus. Comp. Zool., LIV, p. 223, July.
1912. *Noctilio leporinus mastivus* Miller, North American Land Mammals, p. 30, December 31.
1918. *Noctilio leporinus mastivus* Anthony, Indigenous Land Mammals of Porto Rico, p. 340, October 12.
1924. *Noctilio leporinus mastivus* Miller, North American Recent Mammals, p. 40.

Type locality.—Island of St. Croix, West Indies.

Distribution.—Limits of range unknown, but probably the Greater Antilles, the Virgin Islands and St. Croix. Recorded in Porto Rico, Old Loiza, and on Mona Island (Elliot).

Specimens collected.—30 (20 skins and 10 alcoholics), from Old Loiza, near San Juan, on the northern coast.

General characters.—A very large bat with yellowish white dorsal stripe. Head large and rounded; ears high, narrow, pointed, tragus serrate along posterior border; muzzle simple, nostrils tubular; upper lip simple, lower lip and chin with a few dermal, wart-like growths; cheeks and chin sparsely haired; body robust and heavy; humerus very long and nearly straight; thumb large and strong; third phalanx of third digit very long; hind leg very large, with long tibia, long metatarsus and very large claws; calcar well developed and very long; tail short, enclosed, except for extreme tip, in very wide interfemoral membrane; fur very short everywhere, almost woolly; fur restricted along lower back to a narrow median strip, practically no hair on any of the membranes except for a few scattered along lateral membranes; lateral membranes attached rather high on sides of body.

Color.—Adult: Above, snuff-brown, the hairs tipped with buff, with a narrow dorsal stripe of yellowish white running from hind neck almost to base of tail; below, whitish to yellowish or buffy, varying with individual; females yellower below than males. One specimen, No. 39563, adult, varies from normal in being cinnamon-buff below.

Young: When nearly full grown very similar to adults, but more strongly yellow on underparts.

Skull.—Large and strongly constructed; rostrum of normal length but rather broad; nasals slightly arched, premaxillæ thin and inflated, nares opening outward, a pair of foramina at the posterior border of the nasal bones; braincase rounded, globose, with high sagittal and lambdoidal crests; sagittal crest dividing anteriorly and continuing as sharp ridges nearly to the maxillary root of zygoma; mastoid process large, shelf-like, subrectangular; zygomatic arch strong and heavy, flaring widely pos-

teriorly, jugal meeting posterior root of zygoma at a nearly right angle; basioccipital region very short, slightly tilted upward from plane of palate; basisphenoid pits very faintly indicated; sphenoidal fissure very large and extensive; glenoid broad and shallow; bullæ covering about half of cochleæ; palate long and broad, deeply concave, more especially from side to side; interpterygoid fossa short and broadly U-shaped; mandible very heavy; horizontal ramus straight; ascending ramus low and rising in gradual curve from horizontal portion; coronoid higher than condyle, peg-like, condyle noticeably elevated above plane of molar crowns; angular process strong and abruptly reflected outward; dental foramen large and conspicuous, below sigmoid notch. Dentition heavy. Skulls of males heavier, with higher crests than those of females.

Dentition.—I, $\frac{2-2}{1-1}$; C, $\frac{1-1}{1-1}$; Pm, $\frac{1-1}{2-2}$; M, $\frac{3-3}{3-3} = 28$.

Upper: Incisors unequal, inner much larger than outer pair, strongly in contact at mid-height of tooth, but divergent at root and tip; crowns of inner pair very high, with postero-external heel; outer incisors in contact with inner posteriorly, but separated by noticeable diastema from canines, small and low, with internal cusp; canine large and heavy, with well-developed internal cingulum, but no accessory cusps; inner face slightly concave; premolar very short in antero-posterior axis, with high anterior cusp and well-marked internal heel; first two molars similar, subequal, with W-shaped molar pattern of normal type, hypocone much lower than protocone; third molar reduced, lacking metastyle.

Lower: Incisors small, crowded into and completely filling intercanine space, crowns subrectangular, concave, anterior cutting edge faintly bifid; canine large, with strongly marked internal spiral groove, tooth curved forward at base, backward at tip; first premolar small, with low cusp, crowded by second premolar and by canine; second premolar with crown much wider than long, crowded in tooth-row, with well-developed external cingulum, high anterior cusp and low internal cusp; first and second molars with normal W-crown pattern, teeth projecting externally considerably beyond face of ramus; third molar slightly smaller than the other two, but similar in other respects.

Measurements.—Average of 7 adult males: Total length, 132 mm. (127–135); tail vertebrae, 28.3 (27–31); hind foot, 34.4 (34–35); forearm, 86.7 (85–88).

Average of 7 adult females: Total length, 124.7 (118–135); tail vertebrae, 26.1 (25–28); hind foot, 31.1 (30–32); forearm, 83.9 (80–85.8).

Skull.—Average of 5 adult males: Greatest length, 27.3 (26.6–28.5); zygomatic breadth, 20.26 (19.8–20.7); interorbital breadth, 7.2 (7.1–

7.3); breadth of braincase, 13.9 (13.7-14); mastoid breadth, 19.58 (18-20.7); length of palate, 12.64 (12.3-12.9); length of maxillary molar series, 8.72 (8.5-8.9); length of mandible, 19.06 (18.5-19.4); length of mandibular molar series, 9.88 (9.4-10).

Average of 5 adult females: Greatest length, 25.52 (24.9-26.3); zygomatic breadth, 18.86 (18.6-19.1); interorbital breadth, 6.96 (6.8-7.1); breadth of braincase, 13.4 (13.2-13.6); mastoid breadth, 17.2 (16.8-17.8); length of palate, 11.76 (11.5-12.2); length of maxillary molar series, 8.48 (8.3-8.6); length of mandible, 18 (17.7-18.4); length of mandibular molar series, 9.66 (9.5-9.8).

Remarks.—The species of the genus *Noctilio* are among the very largest of the New World bats. On the character of size alone, the Porto Rican *Noctilio* may be readily distinguished from all the other bats found on the island. There is only one other large bat found in the entire West Indies area which surpasses it or even equals it in size. This bat is *Vampyrum spectrum* and it has not been recorded from Porto Rico. The status of the two forms, *leporinus* and *mustivus*, has not been very satisfactorily worked out. Two specimens of *leporinus* from Trinidad are not very different from the series taken on Porto Rico, the Trinidad specimens being somewhat smaller and with the dorsal line less developed.

This large bat was found at but one locality, in a cave known locally as the Piedra de la Cueva, on the outskirts of the little town of Old Loiza, on the north coast. The fact that *Noctilio* had not been reported from Porto Rico before would indicate that its distribution is very local. Extracts from the field journal of the expedition will serve to describe the behavior of this interesting bat.

The first cave we came to, called "Piedra de la Cueva," was a very large, high cave, more a shallow opening into the face of the small hill or huge rock in which it was situated than a cave, in the usual sense of the word. On account of its height the light came through into all parts, and so I did not expect to encounter anything except a few *Artibeus*. A large pile of droppings underneath a darkened crevice overhead led me to fire a shot on suspicion, and I was rewarded by several specimens of the large, hitherto unencountered *Noctilio*. At the report, others began to move about, and investigation showed that the cave had a number of these interesting large bats. They were sufficiently high up to be almost safe from my auxiliary, as the fine shot was not very deadly to such large bats at that distance. However, by pegging away at them I secured a fair number. These bats when disturbed flew out into the bright cave and moved about as surely as if the light were absolutely to their liking. Their flight was quite regular, and while not rapid, like that of most of the smaller species, it was a strong, well-sustained flight. The very large hind legs were stretched out behind, straight from the body and approximately parallel, keeping the interfemoral membrane and the posterior part of

the alar membrane in a flat horizontal plane, while the propulsion was furnished by the membrane on the forearm. They looked almost like large birds, as they circled about the cave overhead, the light shining down through their membranes and the red blood showing in the thin feet. When they alighted they seemed sure of their intention and swooped up directly to a hanging position and did not make several vain preliminary trials, as does *Artibeus*. Their large feet proved admirably suited to hanging, and they crawled about, upside down, with considerable agility, moving sometimes quite a distance before they found a spot that suited them well enough to remain. From below they seemed almost like big spiders crawling about on the rocky ceiling. Considerable of the crawling was done by means of the feet only and the thumbs were used only about half the time. A mother with an almost hairless young flew about the cave a few times, and then, as she had been wounded, flew against the side of the cave and was later secured. The call-note was distinctly different in tone from that of the other bats, being rather high pitched for such a large bat. These bats were very tenacious and, like all the other species, attempted to bite when picked up. They seemed to be crowded in several crevices that led back into the ceiling out of the direct light, but were rather easily alarmed, and a shot or two invariably brought individuals crowding out from such places. *Artibeus* that were found in the same cave did not mingle with these bats and were dwarfed in comparison when flying beside their larger companions of the cave.

A minute, reddish parasite was found dotted over the interfemoral membranes of *Noctilio*. It was a conspicuous feature in spite of its small size, and was seen on no other species of bat taken on Porto Rico. A small ectoparasite found in the fur has been identified by Dr. J. Bequaert as *Paradyschiria fusca* Speiser. This species was characterized by a very strong, disagreeable odor, rather musky in its nature.

Family PHYLLOSTOMIDAE

Subfamily CHILONYCTERINAE

See Miller, The Families and Genera of Bats, p. 116, 1907, for diagnosis of the family; p. 118 for diagnosis of the subfamily Chilonycterinae; p. 119 for diagnosis of the genus *Chilonycteris*.

Chilonycteris parnellii portoricensis (Miller)

Text Fig. 3

- 1902. *Chilonycteris portoricensis* Miller, Proc. Acad. Nat. Sci. Philadelphia, p. 400, September 12.
- 1904. *Chilonycteris parnellii portoricensis* Rehn, Proc. Acad. Nat. Sci. Philadelphia, p. 199, March 29.
- 1911. *Chilonycteris parnellii portoricensis* G. M. Allen, Bull. Mus. Comp. Zool., LIV, p. 225, July.
- 1912. *Chilonycteris parnellii portoricensis* Miller, North American Land Mammals, p. 32, December 31.

1918. *Chilonycteris parnellii portoricensis* Anthony, Indigenous Land Mammals of Porto Rico, p. 343, October 12.
1924. *Chilonycteris parnellii portoricensis* Miller, North American Recent Mammals, p. 42.

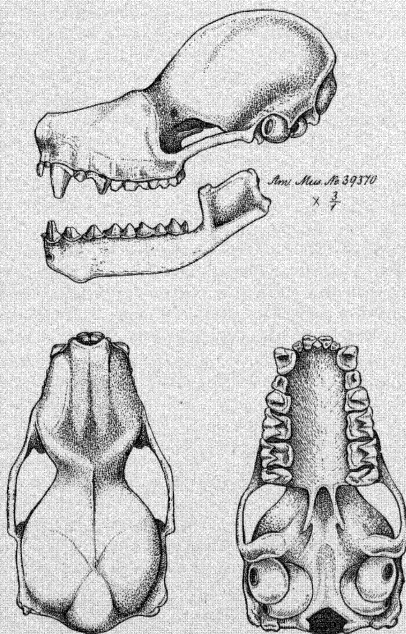


FIG. 3.—*Chilonycteris parnellii portoricensis* $\times 3/4$; adult ♂; Trujillo Alto, Porto Rico

Type locality.—Cueva de Fari, near Pueblo Viejo, Porto Rico.

Distribution.—Known only from the Island of Porto Rico. Recorded from Cueva de Fari, Cueva de Trujillo Alto and Cayey (U. S. Biol. Survey).

Specimens collected.—Two, from Cueva de Trujillo Alto.

General characters.—Size medium; ears tall, rather narrow and pointed, lower border extending outward in a broad shelf covered with long hairs, tragus blunt; nose simple, without leaf; under lip with a pair of transverse cutaneous lappets; forearm but moderately curved; tail short, free for the terminal half; feet of medium size; calcar long and slender; hair of sides not running onto membranes, but a few scattered hairs continuing along humerus and femur and onto the interfemoral membrane for about half its depth; hairs about nose directed forward.

Color.—Above, a uniform brown, about dusky drab, the hairs grayish at base; pelage rather thinner on neck and shoulders allowing more or less of light color at bases of hairs to show through; below, light drab; the hairs of abdomen blackish brown at base, those of the throat but little darker at base than tip; membranes blackish brown; hair everywhere rather long, soft and lax.

Skull.—Of moderate size with high, rounded braincase; rostrum long and somewhat inflated; a nasal concavity present; braincase tilted at an angle to axis of rostrum, globose; zygomata not flaring; interpterygoid fossa short; palate long and narrow, widening slightly anteriorly; cochlea large; mandibular ramus long and curved upward posteriorly; coronoid low, about as high as condyle; angular process deflected outward.

$$\text{Dentition.}—I, \frac{2-2}{2-2}; C, \frac{1-1}{1-1}; Pm, \frac{2-2}{3-3}; M, \frac{3-3}{3-3} = 34.$$

Upper: Inner incisors about twice as large as outer, crowns with broad cutting edge; outer incisors low and crown almost flat; incisors all in contact and no diastema in the entire tooth-row; canines typical, with large internal cingulum and concave internal face; first premolar small, with high anterior cusp and prominent postero-internal basin; second premolar about twice as large as first, with a single, very high, sharp cusp and a wide internal basin; first and second molars with normal W-shaped molar pattern composed of five cusps and four commissures; third molar less than half as large and with only three commissures.

Lower: Incisors subequal, simple, cutting edges trifid; canines with internal cingulum and deep longitudinal grooves on internal and posterior faces; first and third premolars about equal in size, second much smaller; first premolar simple with single high conical cusp; second premolar minute and almost crowded out by first and third premolars; third premolar with high sharp cusp; three molars subequal, the third but little smaller than first two, molar pattern a widened W.

Measurements.—Two males: Total length, 78, 83 mm.; tail vertebrae, 20, 20; hind foot, 12, 13; forearm, 49.5, 51.

Skull.—Total length, 20, 20.4; zygomatic width, 10.8, —; interorbital width, 3.8, 3.9; breadth of braincase, 9.2, —; length of palate, 9.1, 9.1; length of molar series, 6.7, 6.7; length of mandible, 14.4, 14.7; length of mandibular molar series, 8.2, 8.3.

Remarks.—There are two species of the genus *Chilonycteris* occurring on Porto Rico. These two forms may be easily separated on the basis of size. *C. parnellii portoricensis* is much larger than *C. fuliginosa inflata*. It is also apparently a much rarer species and not found in such large numbers. The nearest relative of *portoricensis* is *C. parnellii boothi* of Cuba, from which it differs in smaller size and more inflated skull. In addition, the ear of *boothi* is more pointed and falcate than the ear of *portoricensis*.

Only two specimens of *portoricensis* were taken and it was found only at one place, the Cueva de Trujillo Alto. The type locality for the species is the Cueva de Fari, Pueblo Viejo, but although this cave was visited several times and carefully searched, no *portoricensis* were seen there. It is evidently not a common species anywhere, as the two specimens secured were the only ones seen, and the cave where they were found was visited no less than three times and hunted assiduously in the effort to secure more. The two specimens were found in an inner alcove of the cave, off to one side of the main chamber, from whence they issued with a swarm of the smaller species of *Chilonycteris*, *Monophyllus* and the rare *Mormoops*.

A fossil skull of this species was also found. Among a considerable collection of fossil bat skulls and limb bones picked up in the Cueva Catedral, there is one fairly complete skull of *C. p. portoricensis*. This skull shows no difference whatever from the skulls of the bats living on the island today.

***Chilonycteris fuliginosa inflata* (Rehn)**

Text Fig. 4

- 1878. *Chilonycteris Mac-Leayi* Gundlach (not of Gray), Anales Soc. Espan. Hist. Nat., VII, p. 140 (Part [Bayamon and Mayaguez, Porto Rico]).
- 1904. *Chilonycteris macleayii inflata* Rehn, Proc. Acad. Nat. Sci. Philadelphia, p. 190, March 29.
- 1911. *Chilonycteris macleayii inflata* G. M. Allen, Bull. Mus. Comp. Zoöl., LIV, p. 224, July.
- 1912. *Chilonycteris macleayii inflata* Miller, North American Land Mammals, p. 31, December 31.
- 1918. *Chilonycteris fuliginosa inflata* Anthony, Indigenous Land Mammals of Porto Rico, p. 344, October 12.
- 1924. *Chilonycteris macleayii inflata* Miller, North American Recent Mammals, p. 41.

Type locality.—Cueva de Fari, near Pueblo Viejo, Porto Rico.

Distribution.—Restricted to the Island of Porto Rico. Recorded as follows: Cueva de Fari; Mayaguez (U. S. Nat. Mus.); Cueva de Trujillo Alto.

Specimens collected.—79: Cueva de Fari, Pueblo Viejo, 19 (12 skins); Cueva de Trujillo Alto, 60 (8 skins).

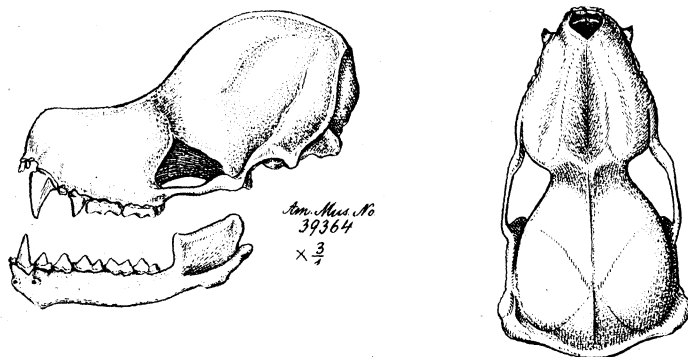


FIG. 4.—*Chilonycteris fuliginosa inflata* $\times 3/1$; adult σ ; Pueblo Viejo, Porto Rico

General characters.—Size very small; ears quite high, narrow and pointed, widening abruptly into an ample conch at base, with two or three tooth-like projections on external border about midway; tragus of moderate length, with distinct notch-like infolding in anterior edge; nostrils simple, without nose-leaf, but having a very low transverse ridge just back of nares; nose-pad with a number of low, rounded excrescences along the margin; lower lip with lateral lobes or folds meeting anteriorly to form a lappet, median region of lappet papillose; body everywhere furred; membranes naked; tail about one-half the length of head and body, free for terminal one-fourth; interfemoral membrane nearly twice as deep as length of tail; calcar very long and slender; femur nearly as long as tibia, both bones slender; humerus strongly bowed; hair of moderate length, soft, denser on back and belly than on neck, stiffer about face and directed forward; a distinct longitudinal parting in the hair at anterior edges of ears, and hair on throat lax and radiating in all directions.

Color.—Two color phases are found in this species—a rich brown phase and a gray brown phase, the latter seemingly the commoner.

Cinnamon-brown phase: Above, color between cinnamon-brown and Prout's-brown, the hairs of the neck lighter at base, ochraceous buff, this color showing through, making the whole general tone lighter; below, hairs posterior to pectoral region between Saccardo's-umber and isabella

color, with hairs darker at base; throat and under side of neck cinnamon-buff, the hairs cinnamon-brown at base. The color is rich, not truly indicated by any single shade.

Bister-brown phase: Above, bister, varying in some individuals to Prout's-brown; hair on neck and shoulders drab-gray, crown like back; below, breast and abdomen like back, the hairs tipped with drab-gray, throat to breast light ochraceous buff, the hairs at base bister, a few hairs on throat drab at base.

Young: Individuals with the teeth sharp and showing little wear, but otherwise fully adult in every particular, have a pelage differing radically from either of the above and seem to be best accounted for by assuming an immature pelage that persists for some time. These individuals are a uniform slate-black above, with the neck pallid neutral gray, and color below nearly as dark as on back, except for throat and inguinal regions, which are lighter, like the neck above. One specimen, No. 39357, appears to be passing from the immature to the bister-brown phase.

These three different pelages, or color phases, while very distinct when selected specimens are compared, nevertheless gradually grade from one to the other in the series from Porto Rico.

Skull.—Small and delicate; elongate, with swollen rostrum and roundly inflated braincase; braincase raised up or tilted to axis of rostrum; zygomatica scarcely expanded; nasals depressed; a sagittal crest, low but distinct from interorbital region to lambdoidal crest; audital bullae inflated; palate normal; pterygoids divergent; mandible with a strong horizontal ramus of nearly uniform depth throughout; ascending ramus low; condyle small and higher than the weak coronoid; angular process subfalciform, strongly divergent externally.

Dentition.—I, $\frac{2-2}{2-2}$; C, $\frac{1-1}{1-1}$; Pm, $\frac{2-2}{3-3}$; M, $\frac{3-3}{3-3} = 34$.

Dentition almost identical, except for size, with that of *Chilonycteris p. portoricensis*, q. v.

Upper: Central pair of incisors bifid and larger than outer pair, which are appressed to sides of first; canine long, slender, sharp; first premolar much smaller than second; second premolar with highest cusp of molar series and well-developed internal cingulum; first two molars equal, with broad crowns and prominent W-shaped pattern; third molar about half as large.

Lower: Incisors subequal, with bifid cutting edges; canine normal; first and third premolars equal, with simple acute cusp, second small and nearly crowded inwardly from tooth-row; molars of nearly equal size, with normal cusps, high and sharp.

The skulls of females do not differ appreciably from those of the males, as they do in the case of the related *macleayii* of Cuba.

Measurements.—Average of 16 specimens, all adults: Total length, 66.25 mm. (62–70); tail vertebrae, 21 (19–26); hind foot, 9.37 (9–10); forearm, 38.41 (37.5–39.5); ear from meatus (average of 5 alcoholic specimens), 15.

Skull.—Average of 10 skulls, a series of 5 adult males and 5 adult females: Greatest length, ♂ 14.88 (14.6–15.1), ♀ 14.84 (14.5–15.1); zygomatic breadth, ♂ 7.56 (7.5–7.7), ♀ 7.54 (7.5–7.6); interorbital breadth, ♂ 2.94 (2.8–3.2), ♀ 3.04 (3–3.1); breadth of braincase, ♂ 6.78 (6.7–6.8), ♀ 6.58 (6.4–6.8); breadth of rostrum outside of m^2 , ♂ 6.14 (6–6.3), ♀ 6 (6–6); length of palate, ♂ 6.76 (6.6–7.1), ♀ 6.66 (6.5–6.8); length of maxillary molar series, ♂ 4.7 (4.6–4.8), ♀ 4.7 (4.6–4.8); length of mandible, ♂ 10.26 (10–10.4), ♀ 10.34 (10.2–10.5); length of mandibular series, ♂ 5.44 (5.3–5.6), ♀ 5.44 (5.3–5.5).

Remarks.—Dr. G. M. Allen discovered the presence of two small species of *Chilonycteris* in Cuba, describing the new one as *C. torrei*, which is distinguished from *C. macleayii* by the presence of two or three minute tooth-like projections on the ear, and lower nose-pad with less prominent protruberances, and slightly smaller size throughout. The Porto Rican subspecies, *inflata*, has the same assemblage of characters which mark *torrei*, and consequently the old designation of *inflata* as a subspecies of *macleayii* had to be revised. The next name available for the small species of West Indian *Chilonycteris* is *fuliginosa* Gray, 1843, occurring in Haiti. Gray's type is in the British Museum and Mr. Oldfield Thomas has examined it and pronounced it to be of the *torrei* style, while four specimens of *Chilonycteris* from Santo Domingo loaned by the Academy of Natural Sciences of Philadelphia, as well as specimens from Haiti in the American Museum, are also similar to *torrei* in the details of ear and nose structure. *Inflata* is thus made a subspecies of *fuliginosa*, and the name of the Porto Rican bat should stand as *Chilonycteris fuliginosa inflata* (Rehn).

Chilonycteris fuliginosa inflata is larger and has a longer calcar than true *fuliginosa* of Haiti, and also shows the extreme degree of rostral inflation for the entire group of small Antillean *Chilonycteris*. In addition to the characters mentioned, which separate it from *macleayii* of Cuba, *inflata* has a broader palate and shorter, broader ear. *C. macleayii grisea* of Jamaica is a larger bat than *C. f. inflata* and may be distinguished by this character.

I secured this bat only in the northern part of Porto Rico, in the San Juan district. A specimen taken at Mayaguez (Rehn, 1904, p. 191) is

in the United States National Museum, and Gundlach (1878, p. 140) records one which he caught in his house in Mayaguez. Although this species might be taken anywhere throughout the island, the field work done by this expedition inclines me to believe that normally it is restricted to a narrow belt along the north coast.

In the Cueva de Fari and Cueva de Trujillo Alto large numbers were found, more especially in the latter. This species prefers deep, narrow fissures or holes in the walls and ceiling and does not often cluster in the more open recesses. When disturbed, the inmates pour out in a rapid stream and disappear like shadows into some other part of the cave. The flight is very swift, but, owing to the small size of this bat, may appear to be more rapid than it actually is. When frightened from a resting place, as a rule they leave the spot with very little reluctance and do not hover about or make tentative returns. This species was not found in houses, as MacLeay found the small *Chilonycteris* in Cuba. A very small bat, possibly *inflata*, was seen at dusk flying over the streets of Lares. No small young were noted with the adults of this species, although young of the other species of bats were quite common at this time (July).

• ***Mormoops blainvillii* Leach**

Text Figs. 5 and 6

See Miller: The Families and Genera of Bats, p. 121, 1907, for diagnosis of the genus.

- 1821. *Mormoops blainvillii* Leach, Trans. Linn. Soc. London, XIII, p. 77, tab. VII.
- 1840. *L[obostoma] cinnamomcum* Gundlach, Weigmann's Arch. f. Naturg., VI, Band 1, p. 357.
- 1878. *Mormops blainvillei* Gundlach, Anales Soc. Espan. Hist. Nat., VII, p. 140 (part) [Porto Rico and Cuba].
- 1902. *Mormoops blainvillii cinnamomca* Rehn, Proc. Acad. Nat. Sci. Philadelphia, p. 165, June 11.
- 1911. *Mormoops blainvillii cinnamomca* G. M. Allen, Bull. Mus. Comp. Zool., LIV, p. 226, July.
- 1912. *Mormoops blainvillii cinnamomca* Miller, North American Land Mammals, p. 34, December 31.
- 1918. *Mormoops blainvillii* Anthony, Indigenous Land Mammals of Porto Rico, p. 346, October 12.
- 1924. *Mormoops blainvillii cinnamomca* Miller, North American Recent Mammals, p. 44.

Type locality.—Casetal, San Antonio el Fundador, Cuba.

Distribution.—Cuba, Santo Domingo, Mona Island and Porto Rico.

Recorded in Porto Rico from Trujillo Alto and from "la parte meridional de la Isla" (Gundlach).

Specimens collected.—Six: Five skins and one alcoholic, Cueva de Trujillo Alto.

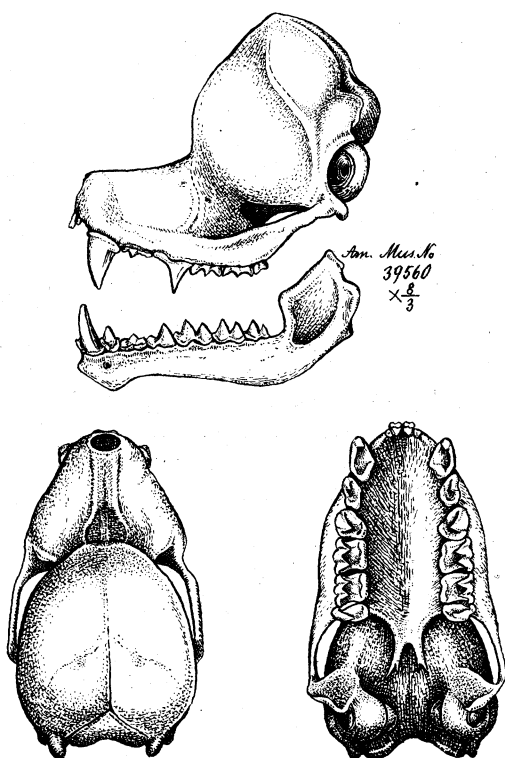


FIG. 5.—*Mormoops blainvillii* $\times 8/3$; adult σ ; Trujillo Alto, Porto Rico

General characters.—A small or medium size bat with grotesque head and face and wide interfemoral membrane; face very short; muzzle with small pad, but no nose-leaf; upper lip with two small fleshy processes on either side of nostril, and notch opposite first premolar; lower lip and chin with complex pad of fleshy leaflets, surface papillose; ears large, exceedingly broad, not joined across forehead, lower margin of ear conch broad and shelf-like; tragus large, complex, with subterminal process; eye small and located in enclosure made by ear, a small wart-like ridge at posterior border of eyelids; humerus of normal length, strongly bowed, pollex small and weak; femur and tibia long, hind foot small and delicate, calcar very long and well developed; tail long, enclosed, except for

tip, in very broad interfemoral membrane; membranes very thin and delicate, everywhere naked; fur long, lax, and exceedingly soft and silky.

Color.—Two types of coloration are represented. Four skins are as follows: above, uniform Saccardo's-umber, the hairs distinctly lighter basally; below, about vinaceous buff. The fifth skin, No. 39558, is much darker than the others. Above, Prout's-brown; below, between cinnamon-brown and ochraceous-tawny.

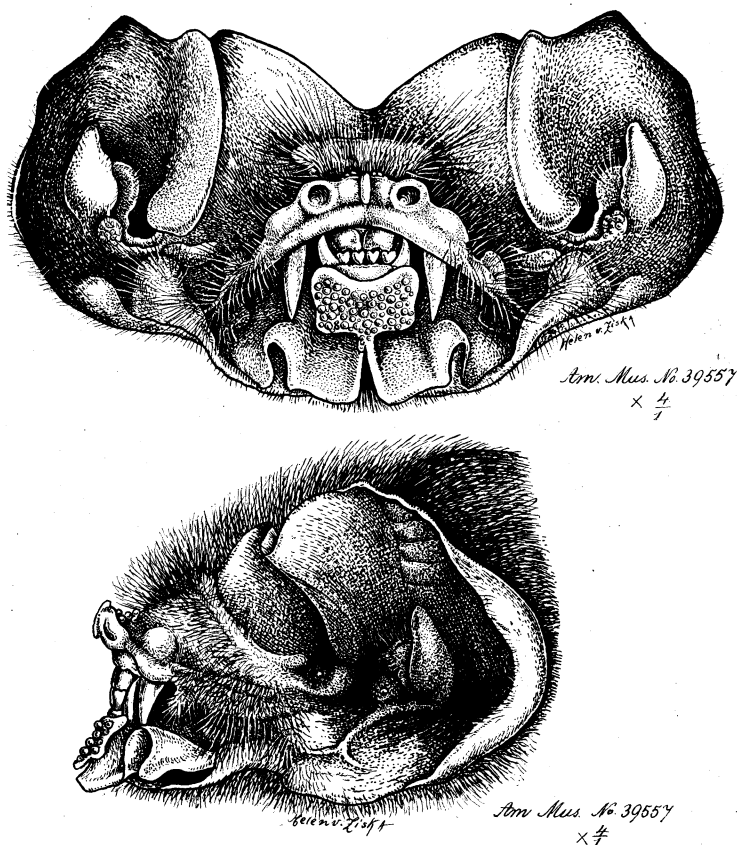


FIG. 6.—*Mormoops blainvillii* $\times 4/1$; adult σ ; Trujillo Alto, Porto Rico

Skull.—Small and rather delicate; rostrum about as broad as long, with median nasal depression and inflated maxillaries; braincase globose, tilted to the axis of the rostrum so that frontal region makes an angle of almost 90° with rostrum; sagittal crest faintly indicated; mastoid process not expanded from braincase; zygomatic arches scarcely flaring; jugals nearly parallel; palate long, narrow, shallowly concave posteriorly; ptery-

goid processes depressed from palatal plane; glenoid large, rather flat; bullæ large, about equal to cochleæ; mandible long and narrow; horizontal ramus long, of good depth, ascending ramus broadly curving upward; coronoid very low, about midway between the condyle and molar plane; condyle high above molar crowns; angular processes flaring outward; dentition strong.

$$\text{Dentition.}—I, \frac{2-2}{2-2}; C, \frac{1-1}{1-1}; Pm, \frac{2-2}{3-3}; M, \frac{3-3}{3-3} = 34.$$

Upper: Inner incisors strongly in contact, with expanded crowns and looking somewhat as if they had been rotated slightly on the body of the tooth, cutting edge trenchant and bifid; outer incisors very minute, subterete, crowded against inner pair; noticeable diastema between canines and incisors; canine long, compressed, with keen cutting edges; first premolar very low-crowned, with very sharp median cusp and low posterior concavity; second premolar with highest cusp of molar series; first and second molars subequal, normal in detail, with W-shaped crown pattern, as in *Chilonycteris*; third molar reduced, lacking a cusp and a commisure of the W.

Lower: Incisors equal, small, cutting edges trifid, forming a close row, slightly convex between canines; canine simple, sharp; three premolars subequal, second smaller than first or third, with single trenchant cusps; three molars similar in detail, of nearly equal size, with normal cusps well developed.

Measurements.—Average of 5 adult females: Total length, 83.8 mm. (80–86); tail vertebrae, 29 (28–30); hind foot, 10.5 (10–11); forearm, 46.7 (46–48).

Skull.—Average of 5 skulls: Greatest length, 14.1 (13.8–14.4); zygomatic breadth, 8.55 (8.5–8.6); interorbital breadth, 4.4 (4.3–4.5); breadth of braincase, 7.38 (7.3–7.6); length of palate, 8.4 (8.1–8.8); length of maxillary molar series, 6.2 (6–6.4); length of mandible, 12.06 (11.9–12.2); length of mandibular molar series, 7.36 (7.2–7.5).

Remarks.—*Mormoops blainvillii* apparently remains unchanged over rather an extensive range, since specimens from Jamaica, Haiti, Cuba, Mona Island and Porto Rico are indistinguishable from one another. The question is complicated by the extreme variability in color shown by all the species of this genus, but the skull characters identify the Porto Rican specimens with the Cuban series. From *M. b. blainvillii* of Jamaica, *M. b. cinnamomea* has been differentiated by Rehn (1902, pp. 165–166), the reviser of the genus, on the character of the first upper premolar, “greatly expanded posteriorly.” I have examined the same speci-

mens which Rehn had, with the advantage of additional specimens (the total number of West Indian *Mormoops*, 31, as follows: Jamaica, 15 skins and alcoholics with 12 skulls; Cuba, 4 skins and alcoholics with 4 skulls; Haiti, 1 alcoholic with 1 skull; Mona Island, 5 alcoholics with 5 skulls; Porto Rico, 6 skins and alcoholics with 5 skulls), and find that I am unable to distinguish more than one form in the lot. The shape of the first upper premolar varies somewhat with the individual and I can see nothing to indicate subspecific separation for the Porto Rican animal. The degree of rostral inflation varies as well.

None of the Porto Rican animals show the intense ochraceous coloration attained occasionally by this species elsewhere, but doubtless this is a condition due to the small size of the series, and more extended collecting would secure the bright individuals.

Mormoops appears to be a rare bat in Porto Rico, as it was seen in but one cave, Cueva de Trujillo Alto, and then only in very small numbers. One was secured July 7 after several shots had been fired into a chamber teeming with *Monophyllus*, and on later visits, July 14 and 20, a very few were found to be hanging in crevices in a small, elevated chamber, to which it was rather difficult to ascend from the main floor of the cave. Here it was consorting with the smaller *Chilonycteris* and *Monophyllus*, being found mingled with masses of these two genera. When in flight, which was generally only after all the other bats had departed, this species would alight on the first favorable spot, seemingly heedless of the light and confusion or else bewildered by such strange happenings, where it could be struck with a bit of brush. It is easily the most grotesque in appearance of any of the bats on Porto Rico, because of its very peculiar ears and complexly ornamented lower lip.

With the fossil remains of *Nesophontes*, *Stenoderma*, *Phyllonycteris* and other bats were found three skulls and two mandibles of *Mormoops*. The fossil skulls differ to no appreciable extent from recent skulls of *Mormoops*.

Subfamily GLOSSOPHAGINAE

See Miller: The Families and Genera of Bats, p. 136, 1907, for diagnosis of subfamily; p. 139 for diagnosis of genus.

***Monophyllus portoricensis* Miller**

Text Fig. 7

1900. *Monophyllus portoricensis* Miller, Proc. Washington Acad. Sci., II, p. 34, March 30.
1911. *Monophyllus portoricensis* G. M. Allen, Bull. Mus. Comp. Zool., LIV, p. 231, July.

1912. *Monophyllus portoricensis* Miller, North American Land Mammals, p. 40, December 31.
 1918. *Monophyllus portoricensis* Anthony, Indigenous Land Mammals of Porto Rico, p. 348, October 12.
 1924. *Monophyllus portoricensis* Miller, North American Recent Mammals, p. 51.

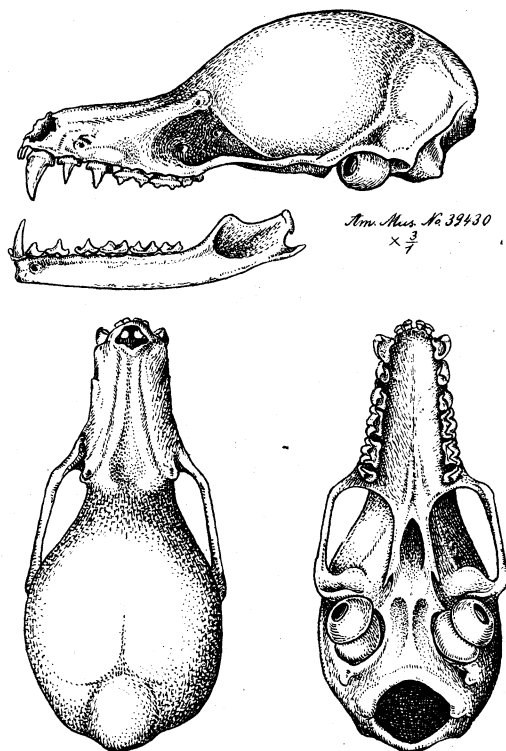


FIG. 7.—*Monophyllus portoricensis* $\times 3/4$; adult σ ; Pueblo Viejo, Porto Rico

Type locality.—Cave near Bayamon, Porto Rico.

Distribution.—Known only from the Island of Porto Rico. Recorded from Bayamon, Cueva de Fari (near San Juan), Cueva de Trujillo Alto and Cayey (U. S. Biol. Survey).

Specimens collected.—125: Cueva de Fari, Pueblo Viejo, 3 skins; Cueva de Trujillo Alto, 122 (15 skins).

General characters.—Size small; nose and ears simple; tail very short, nose-leaf low, pointed; ears of medium height, about as broad as high, rounded at tip; tragus simple, straight; chin with median cleft; tail about 7 mm. long, free at tip; interfemoral membrane very narrow and

attached to a greatly reduced calcar; feet small; humerus haired on proximal third above and below, no hair on membranes elsewhere; hair everywhere soft and of moderate length.

Color.—Adults: Above, bone-brown, rather lighter on sides of neck; hair everywhere above practically unicolor except for minute grayish tipping of some hairs which suggests a frosted appearance; below, hairs bister at base, vinaceous buff at tips; membranes brownish black, ears hair-brown.

Young: Everywhere darker than adults; color above, blackish brown; below, deep mouse-gray.

Skull.—Long, slender and delicately constructed; rostrum very long, slender and tubular; braincase large, rounded and smooth, not rising abruptly from plane of rostrum; zygomatic arches complete, but very light; bullæ of moderate size, but smaller than cochleæ; dentition very weak; palate long and narrow; basisphenoid pits distinct; mandible long, slender and nearly straight; coronoid low; condyle in plane of coronoid; angular process slightly deflected outward.

Dentition.—I, $\frac{2-2}{2-2}$; C, $\frac{1-1}{1-1}$; Pm, $\frac{2-2}{3-3}$; M, $\frac{3-3}{3-3}$ = 34.

Upper: Incisors about equal in size, very small, simple, outer pair inclined toward but not in contact with inner pair; diastema between incisors and canines; canine sharp and dagger-like, with internal anterior and posterior cutting edges and a poorly developed cingulum; first premolar with high, sharp, median cusp, the entire crown being sharp and narrow; second premolar like first, but rather larger; first two molars with sharp-cusped W-shaped crowns and extensive internal basins; last molar smaller and lacking the complete W.

Lower: Incisors often lacking in adult, but when present are very minute, simple, peg-like, not in contact with one another or with canine, crowns very low; canine sharp and with posterior cingulum; premolars like those of upper series, but the first one lacking the well-developed median cone; molars similar to upper molars, but very narrow and long, with a reduced external basin.

Measurements.—Average of 18 specimens from Cueva de Fari and Cueva de Trujillo Alto: Total length, 66.8 mm. (63–71); tail vertebrae, 8.8 (7–10); hind foot, 11.4 (11–12); forearm, 36.7 (36–38).

Skull.—Average of 5 adult skulls: Total length, 19.8 (19.4–20.3); zygomatic width, 8.5 (8.3–8.7); interorbital width, 3.86 (3.8–3.9); breadth of braincase, 8.32 (8.2–8.4); length of palate, 9.4 (9.3–9.5); length of molar series, 5.6 (5.6–5.6); length of mandible, 12.36 (12.1–12.8); length of mandibular molar series, 6.38 (6.2–6.8).

Remarks.—The genus *Monophyllus* is known only from the West Indies, where it occurs as different species on several islands. The genus is well characterized, and *Monophyllus portoricensis* is not liable to be confused with any other Porto Rican bat. *M. portoricensis* differs from the species of *Monophyllus* on neighboring islands by its smaller size, having a forearm less than 40 mm. The *Monophyllus* of Jamaica has a larger skull than that of the Porto Rican species, while the rostrum is proportionally much shorter and more tubular. *M. cubanus* of Cuba is quite similar to *M. portoricensis*, but the latter may be distinguished by a smaller skull, shorter rostrum and more rounded braincase.

This small bat was encountered in great numbers in the Cueva de Trujillo Alto, where it outnumbered all of the other bats. Here it was clustered in masses, hanging in deep crevices, or "chimneys," in the ceiling of the cave, and generally appeared to be segregated by sexes. Thus, out of 83 specimens collected on July 14, 80 were males. This species appeared to be rather loth to leave a locality, and even when disturbed flies about in fluttering circles several moments before leaving the spot for good. After several shots had been fired the bats would move on into an adjacent chamber. Some individuals which were knocked down into the stream that flowed through the cave lost little time swimming to the edge and crawling out. Others, which had been knocked down by means of a handful of slender branches and were not very seriously injured, crawled down into a deep fissure between the earth and the rocky wall of the cave and behaved very much like so many mice. When this species was flying about in a wild and disturbed condition, I often noted a metallic buzzing sound that seemed to be made by *Monophyllus*, and yet it was unlike any noise that I had hitherto heard made by bats. It was more suggestive of the droning flight of a huge beetle, and possibly may have been made by individuals with shot-pierced wings. The flight of this bat is strong, but not particularly erratic or angular.

Monophyllus was found only sparingly in the Cueva de Fari near Bayamon. These two localities, Cueva de Fari and Cueva de Trujillo Alto, were the only places where *Monophyllus* was taken by this expedition, but an additional record from the United States Biological Survey gives Cayey as a third locality.

This species was found as a fossil in the Cueva Catedral. A single fragmentary skull agrees well with skulls of the present-day animal. The fossil *Monophyllus* was found associated with *Monophyllus frater*, *Phylonycteris major* and other species now extinct.

Monophyllus frater Anthony

Text Fig. 8

1917. *Monophyllus frater* Anthony, Bull. Amer. Mus. Nat. Hist., XXXVII, p. 565, September 7.
 1918. *Monophyllus frater* Anthony, Indigenous Land Mammals of Porto Rico, p. 349, October 12.
 1924. *Monophyllus frater* Miller, North American Recent Mammals, p. 51.

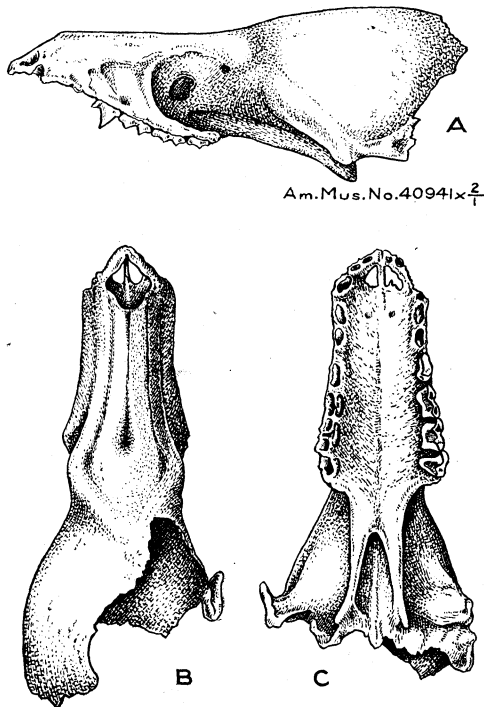


FIG. 8.—*Monophyllus frater* $\times 2/1$; type; Morovis, Cueva Catedral, Porto Rico

Type locality.—Cave near Morovis, Porto Rico. The type is a broken skull with complete rostrum and palate, but with most of the braincase missing; the only teeth present are the last premolar and the three molars of the left side. Topotypes supply a few details indeterminable from the type.

Distribution.—Known only from the Island of Porto Rico.

Specimens collected.—Five fragmentary skulls, only one of which, the type, shows any great assemblage of characters, but all are unmistakably of the same species. They were collected in the Cueva Catedral, near Morovis.

General characters.—Very similar to *Monophyllus portoricensis*, but decidedly larger.

Skull.—Narrow and elongate; rostrum very long, tubular, with shallow nasal depression in region of terminal suture, external nares subelliptical, opening decidedly upwards; interorbital constriction scarcely noticeable; braincase incompletely known, but of rounded type; zygomatic arch doubtless complete; palate long, narrow, shallowly concave posteriorly, incisive foramina large; interpterygoid notch about midway between last molars and tips of pterygoid processes; dentition normal for the genus. Mandible unknown.

Dentition.—Only upper dentition known from specimens, lower dentition assumed to be normal and so indicated in following formula:

$$I, \frac{2-2}{2-2}; C, \frac{1-1}{1-1}; Pm, \frac{2-2}{3-3}; M, \frac{3-3}{3-3} = 34.$$

The first tooth of the series present is the second premolar, but the alveoli of the incisors, canine and first premolar indicate a strictly normal *Monophyllus* dentition. Cusp of second premolar, the highest of the molar series, triangular in outline, with trenchant edges and conspicuous anterior and posterior accessory cusp on cingulum; molars with flattened-out and widened W-pattern, the cusps well developed, the commissures low; third molar with W incomplete, lacking the posterior stroke; outline of posterior border of first two molars with distinct indentation.

Measurements of Monophyllus

	Inter-orbital breadth	Breadth of rostrum at m ²	Length of palate	Breadth of palate inside m ²	Alveolar length of maxillary molar series
<i>Monophyllus frater</i>					
40941*.....	4.6	5.5	12.4	3.6	7.1
40944.....	4.8	.....	11.6	3.8	6.8
40945.....	4.9	.....	12.7	.....	.....
<i>Monophyllus portoricensis</i>					
39431.....	3.8	4.5	9.3	2.9	5.3

* Type.

Remarks.—This large species of *Monophyllus*, while not found living today, was apparently contemporaneous with the smaller *M. portoricensis* at the time that the cave deposits were laid down. A typical skull of the smaller *portoricensis* found in the same deposit with the skull of *frater* would indicate that the two forms were living as distinct species. Had

this material not been discovered associated, the natural assumption to make would account for *portoricensis* as a descendant of *frater*. The relationship of *frater* and *portoricensis* is quite close, however, and the differences appear to be in size rather than in detail. The two may be distinguished most readily by the greater length and breadth of rostrum and palate and by the much heavier dentition of *frater*.

M. frater appears to be the largest species of the genus *Monophyllus*. It is larger than *M. luciae*¹ from the Island of St. Lucia, Lesser Antilles, having a longer rostrum and noticeably longer tooth-row.

It is quite possible that *frater* may yet be found living, and only a longer period of careful and extensive collecting can definitely prove this point.

Subfamily STENODERMINAE

See Miller: The Families and Genera of Bats, p. 149, 1907, for diagnosis of the subfamily; p. 152 for diagnosis of the genus *Brachyphylla*.

***Brachyphylla cavernarum* Gray**

Text Fig. 9

- 1834. *Brachyphylla cavernarum* Gray, Proc. Zoöl. Soc. London, for 1833, No. XI, pp. 122-123, March 12.
- 1911. *Brachyphylla cavernarum* G. M. Allen, Bull. Mus. Comp. Zoöl., LIV, p. 233, July.
- 1912. *Brachyphylla cavernarum* Miller, North American Land Mammals, p. 43, December 31.
- 1918. *Brachyphylla cavernarum* Anthony, Indigenous Land Mammals of Porto Rico, p. 350, October 12.
- 1924. *Brachyphylla cavernarum* Miller, North American Recent Mammals, p. 54.

Type locality.—Island of St. Vincent, West Indies.

Distribution.—Islands of St. Vincent, St. Lucia, Dominica, Montserrat, Antigua, Barbuda, Porto Rico, Cuba, Isle of Pines, and doubtless other islands not yet closely investigated. Recorded in Porto Rico from Pueblo Viejo, Trujillo Alto, Cayey, Corozal and Comerio (U. S. Biol. Survey).

Specimens collected.—49: Pueblo Viejo, Cueva de Fari, 18 (8 skins); Cueva de Trujillo Alto, 10 (3 skins); Cayey, 1; Corozal, 20.

General characters.—A large, heavy-bodied bat with rudimentary nose-leaf, no-external tail, and pale in color. Head large and rounded; pad

¹ Through the kindness of Mr. Gerrit S. Miller, Jr., the author has been able to borrow specimens of *Monophyllus luciae*, *clinedaphus* and *plethodon* from the collection of the United States National Museum, and has thus, with the material in the American Museum, examined all the known specimens of the genus.

on muzzle, and nose-leaf represented by a low transverse ridge, faintly emarginate at middle and lacking any upright process; ears of moderate size, not reaching to tip of nose when laid forward, tips somewhat rounded; tragus tall, broad, with two wide notches on posterior border; humerus long, heavy, noticeably bowed; pollex long and strong; tibia and

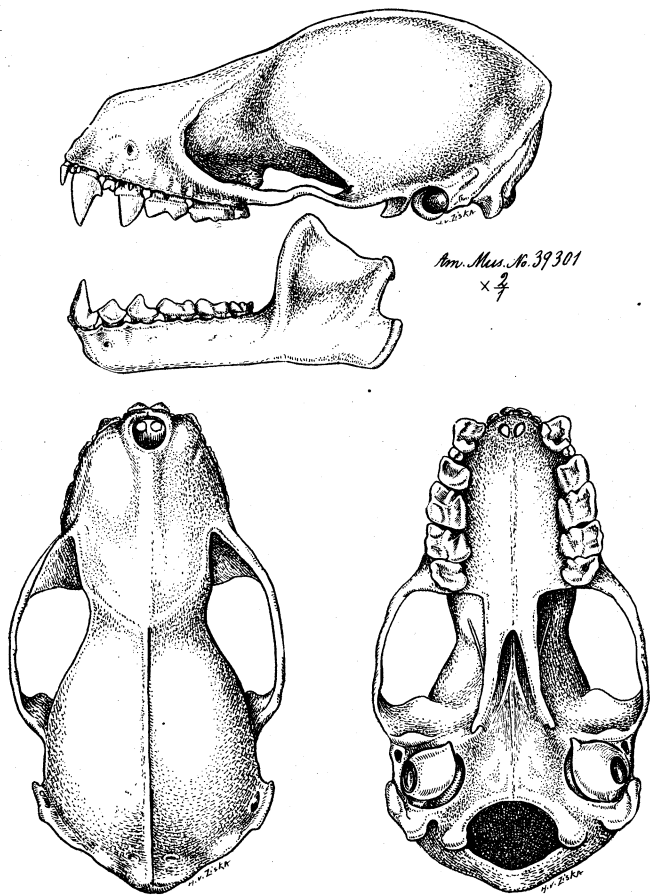


FIG. 9.—*Brachyphylla cavernarum* $\times 2/1$; adult ♀; Pueblo Viejo, Porto Rico

foot of normal length, calcar present but very small; no visible external tail; interfemoral membrane narrow; membranes very thick, heavily wrinkled between humerus and tibia; no hair on membranes except scattered hairs on interfemoral membrane; pelage of moderate length, with slight tendency to be woolly.

Color.—Adults: Above, tips of hairs warm sepia, greater length of the

hair ivory yellow, the exact tone varying with the individual; patches on neck, shoulders at base of ears, and along sides having a much lighter appearance than rest of upper parts because many of the hairs lack the dark tips; underparts wood-brown, the hairs unicolor to the base except on throat, where they are slightly paler at the base; membranes blackish brown.

Immature: Animals as large as the adults, but not yet in adult pelage, are colored as follows: above, hairs tipped with deep mouse-gray, on the rump and flanks the hairs practically unicolor to base, a patch along either side of neck to shoulders white to gray basally; below, mouse-gray. Considerable variation in the amount of dark tipping to the hairs is shown.

Skull.—Large and strongly constructed; rostrum slightly longer than broad, flattened across nasal suture, but not excessively so, nasals slightly elevated above plane of upper border of maxillary, external nares opening upward and outward; interorbital constriction slight; braincase long, well rounded, greatest breadth posteriorly, well-developed sagittal crest, mastoid process very poorly developed; zygomatic arches wide-spread, evenly flaring; palate long, U-shaped, shallowly concave, interpterygoid notch not reaching plane of zygomatic root of maxillary; basisphenoid pits shallow, widely separate; bullæ large and completely covering cochlea; mandible strong and heavy; horizontal ramus deep, slightly concave along lower border; ascending ramus broadly expanded; coronoid very wide, much higher than condyle, subfalcate; condyle slightly above plane of molar crowns; angular process very broad, posterior border a wide curve ending above in an abrupt shoulder, deflected but slightly; dentition heavy.

Dentition.—I, $\frac{2-2}{2-2}$; C, $\frac{1-1}{1-1}$; Pm, $\frac{2-2}{2-2}$; M, $\frac{3-3}{3-3}$ = 32.

Upper: Inner incisors large, in contact at midpoint of tooth, cutting edge a high triangle, posterior cingulum present; outer incisors minute, in contact with crowns of inner pair, but not extending above their cingula, peg-like in shape with slightly expanded crowns; canine large and heavy, with antero-internal cutting edge, prominent posterior accessory cusp, well-developed internal cingulum bearing two low cusps; first premolar small, with crown almost same in cross-section as body of tooth, cutting edge bilobed, crowded between canine and second premolar; second premolar with very high cusp on cutting edge, the highest cusp in molar series, with narrow internal cingulum and low cusp; first and second molars similar, second slightly the larger, crowns wider than long,

greatest breadth externally, external cutting edge with two trenchant cusps, protoconule and metaconule present but small, internal cusp or protocone of good size, crushing surface concave with a few coarse wrinkles; third molars less than half size of first, with concave crushing surface and two external and two internal cusps, all low.

Lower: Incisors equal, crowded against canines and one another to form a slightly convex row, crowns flattened, and borders slightly rounded; canines strong and sharp, with well-marked posterior heel; first premolar smaller than second, more than half as high, with triangular, trenchant cusp and internal cingulum; second premolar with cusp much the highest of the molar row and even approximating the canine; first and second molars with broad, flattened crowns, with low cusps and wrinkled surfaces; third molar nearly as large as first, with crown similar in appearance but with rather high metaconid.

Measurements.—Average of 11 adult specimens, 2 males, 9 females: Total length, 107.3 mm. (100–118); hind foot, 22 (21–23); forearm, 64.5 (63–66.4).

Skull.—Average of 10 adult skulls, 3 males, 7 females: Greatest length, 31.5 (30.1–32.3); zygomatic breadth, 17.13 (16.3–17.8); inter-orbital breadth, 6.38 (6–6.8); breadth of braincase, 12.53 (11.8–12.9); length of palate, 12.86 (12.3–14); breadth of palate outside m^2 , 11.48 (11.2–11.9); length of maxillary molar series, 8.73 (8.6–9); length of mandible, 20.73 (20.2–21.4); length of mandibular molar series, 10 (9.8–10.2).

Remarks.—This large, robust-bodied bat may be easily identified in the field by its peculiar light coloration, narrow interfemoral membrane, its muzzle with the low transverse ridge and no upright leaf or process, and lack of a tail. Next to *Noctilio leporinus mastivus*, it is the largest of the Porto Rican bats, although it is closely approached in size by *Artibeus jamaicensis*. From *Artibeus*, *Brachyphylla* may be told by the lack of a nose-leaf and the much paler coloration.

Brachyphylla cavernarum ranges over a rather extensive area without any apparent differentiation. Specimens from Porto Rico agree quite well with specimens from St. Vincent, the type locality, as well as with specimens from other West Indian islands. Doubtless *Brachyphylla* ranges throughout most of Porto Rico, but it was found only along the north coast and the northwestern parts of the island. Usually it was found in large numbers if the cave was of any size. It appeared to be truly a cave-dwelling bat and was not found in any other situation.

It is often found associated with *Artibeus*, since the two are very similar in their habits. Both genera frequently use well-lighted caves and

even in extensive caves are found quite close to the entrance. *Brachyphylla* is decidedly quarrelsome in disposition, and bats which are at rest show their petulant nature when a new-comer attempts to crowd in, greeting the intruder with angry squeaks. The call-note is a strident, rasping squeak. Because of the aggressive disposition of this species, live specimens must be handled with care, for it is always ready to bite and capable of quite a severe nip.

Nursing females were collected on July 5, but no small young were noted.

Dr. Bequaert has identified as *Pterellipsis aranea* Coq. parasites which were taken from the fur of this bat.

Considerable fossil material of this species was collected in the Cueva Catedral. A careful comparison of some 25 skulls thus found with those of recent *cavernarum* shot on the island show no differences worthy of mention, and extensive measurements demonstrate the two series to be practically identical in detail.

***Stenoderma rufus* Oken**

Text Fig. 10

See Miller: The Families and Genera of Bats, p. 165, 1907, for diagnosis of genus.

1813. ? *Stenoderma rufum* Geoffroy, Descr. de l'Egypte, II, p. 114.

1816. *St[enoderma] rufus* Oken, Lehrbuch der Naturgesch., pt. 3, II, p. 922.

1876. *Stenoderma rufum* Peters, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 430, Pl. 1, Figs. 1-6.

1911. *Stenoderma [rufum]* G. M. Allen, Bull. Mus. Comp. Zool., LIV, p. 238, July.

1918. *Stenoderma rufum* Anthony, Indigenous Land Mammals of Porto Rico, p. 352, October 12.

1924. *Stenoderma rufus* Miller, North American Recent Mammals, p. 61.

Type locality.—Unknown.

Distribution.—Unknown. Recorded from Porto Rico, from the Cueva Catedral, as fossil.

Specimens collected.—25 good-sized specimens of skulls, some nearly complete, 10 mandibles and smaller fragments too small to list in detail.

General characters.—"Nez simple. Oreilles petites, latérales et isolées, oreillon intérieur. Membrane interfémorale rudimentaire, bordant les jambes. Queue nulle." (From description of Geoffroy.)

Skull.—Short and broad in general proportions; rostrum very broad, shortened; nasal region deeply depressed and bordered laterally by high supraorbital ridges coming off from the bifurcation of the sagittal crest,

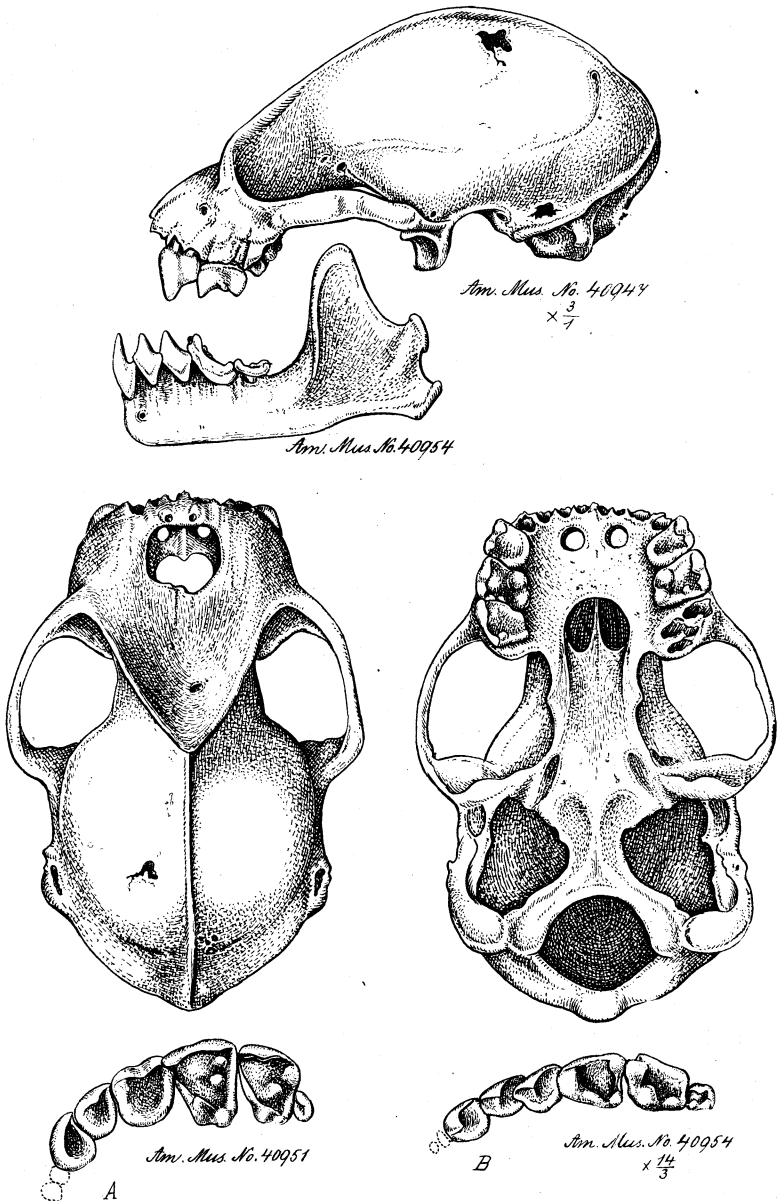


FIG. 10.—*Stenoderma rufus*. Skull figures $\times 3/1$; dentition $\times 14/3$; Morovis, Cueva Catedral, Porto Rico

A—crown view of maxillary tooth-row;
B—crown view of mandibular tooth-row.

external nares opening almost entirely upward, subcircular in outline; zygomatic arches heavy, widely flaring; braincase high and inflated, but compressed laterally rather than evenly rounded, low sagittal crest present, mastoid process poorly developed; palate very broadly horseshoe-shaped with deep posterior emargination reaching nearly to plane of first molar, large incisive foramina well separated from roots of incisors and from each other; pterygoid process short, low, triangular, interpterygoid fossa U-shaped, very long; glenoid well developed, post-glenoid process very heavy; basisphenoid pits large and prominent; bullæ not present in Porto Rican material, figured by Peters (*l. c.*) as of good size; mandible wide and heavy; horizontal ramus very deep, rather short, ascending ramus wide with very high coronoid, low, wide condyle slightly elevated above molar plane and angular processes scarcely deflected.

Dentition.—I, $\frac{2-2}{2-2}$; C, $\frac{1-1}{1-1}$; Pm, $\frac{2-2}{2-2}$; M, $\frac{3-3}{3-3}$ = 32.

Incisors above and below missing in Porto Rican skulls and descriptions of these teeth taken from Peters' figures; all other teeth described from actual specimens.

Upper: Inner incisors very much larger than outer pair, with slender crowns; outer incisors about half as high as inner, with well-developed cingulum and low accessory cusp; all incisors in contact with each other and with canines; canine not very well developed, with good cingulum and very low internal accessory cusp; greatest transverse extent of canine almost at right angles to main axis of skull; entire molar tooth-row very much crowded, the teeth tightly pressed against each other; first premolar nearly as high as canine, which it roughly resembles, with a single trenchant cusp rising high on external border of tooth; second premolar fully as high or slightly higher than canine, with tall, subtriangular main cusp, lower posterior accessory cusp on external cutting edge and with concave internal basin; first molar with main cusp as high as that of second premolar, protocone well developed, hypocone present but small, metaconule as a low, rounded cusp, paracone the main cusp, very high, with trenchant edges, metacone similar but rather lower, with faintly bilobed edge, internal crushing basin concave; second molar slightly smaller than first, similar in general pattern but with metacone much lower and with an internal cingulum across entire flank of paracone, outline of crown subtriangular; third molar minute, closely appressed to second molar, crown flattened, subelliptical in outline, with two low cusps, probably protocone and paracone.

Measurements of Steudodermia rufus

	Greatest length exclusive of incisors	Length from anterior border foramen magnum to tip of premaxillæ	Zygomatic breadth	Inter-orbital breadth	Breadth of brain-case	Breadth of rostrum at m ¹	Length of palate from anterior border post-palatinal notch to posterior border of incisive alveoli	Breadth of palate inside m ¹	Length of maxillary molar series	Greatest length of mandible	Length of mandibular molar series
40947...	23.1	17.1	15.7	5.3	11.3	10.3	3.6	5.0	6.5*	.....	.....
40948...			15.6	5.6	11.4	10.3	3.6	4.9	6.5*	.....	.....
40949...			15.2	5.4	.....	10.	3.6	4.6	6.2*	.....	.....
40950...			15.8	5.7	.....	10.5	3.8	5.2	6.5*	.....	.....
40951...			15.3	5.3	10.6	10.	3.8	4.6	6.6†	.....	.....
40952...			15.8	5.8	.....	10.	3.9	4.7	6.5†	.....	.....
40953...										13.2	6.8†
40954...										13.	6.8†
40955...										12.5	6.5*
40956...										13.3	6.6*

* Alveolar length taken because of absence of some of the molar series.

† Crown length taken, all of the molar series present.

Lower: Incisors small, equal, forming convex row between canines; canine scarcely larger than premolars, with internal and external cutting edges and anterior face of tooth peculiarly flattened, a decided notch at external base of crown where it meets a poorly developed cingulum; premolars with very flat external aspects; first premolar with high triangular crown having very trenchant edges and an internal cingulum; second premolar larger than first, with a high, sharp cusp on the anterior border of the crown which is overlapped externally by the posterior border of the first premolar; first molar largest of series with main cusp, protoconid, as high as main cusp of premolars, metaconid and hypoconid present as much lower cusps upon a flattened posterior basin, and with antero-internal cingulum; second molar with much lower crown, the protoconid, metaconid and entoconid as low but distinct cusps, the hypoconid scarcely discernible, a well-developed external cingulum; last molar very small, with low, flattened crown showing protoconid and metaconid with a posterior internal cusp, possibly the entoconid.

Remarks.—*Stenoderma rufus* for over a century stood as a name only. The habitat of the species was unknown, although it was shrewdly surmised by Dr. G. M. Allen (1911, p. 238) that the homeland of the species was in the West Indies, and this conjecture accorded with the ideas of most workers on American Chiroptera. The animal was described by Etienne St. Hilaire Geoffroy in a work on Egypt dated 1813 (see Lyon, 1914, p. 217), but the type locality was not given. The natural assumption would be that the bat was African, but later workers felt that its New World origin was not to be doubted. For over fifty years nothing was added to the description of Geoffroy, and it stood as an animal of unknown habitat and poorly understood characters until Peters, in 1869, visited the Paris Museum and examined the type. He found the type represented by a damaged skin from which the skull had been removed and lost. Peters was deceived by the faulty figure of Geoffroy, and as a result he made *Stenoderma* out to be *Vampyrops* (Peters, 1869, p. 399). Later on Peters had occasion to examine the type of *Artibeus undatum* Gervais in the anatomical collection of the Paris Museum (Peters, 1876, p. 432). The similarity between the skull of *undatum* (the type of *undatum* was a skull, the skin of which was supposed to be lost) and the skull figured by Geoffroy at once impressed Peters, who came to the conclusion that the skull of *undatum* was the long-lost skull of *Stenoderma rufus*. This interpretation was evidently accepted by Dobson (1878, p. 529), who wrote that the type of *Stenoderma rufus* was represented by a skin, in bad condition, and a skull in the Paris Museum. The work of Peters is important because he was able to demonstrate the existence of

such an animal as *Stenoderma rufus* and to define its well-marked characters, thus putting to an end a condition which had allowed *Stenoderma rufus* to be confused with *Molossus rufus* and *Desmodus rufus*.

Finally, in 1916, *Stenoderma rufus* was discovered as a fossil and the habitat, in part, at least, of this species was disclosed. Some of the obscurity of the previous 100 years was dispelled, but there still remains this interesting condition. In Porto Rico this bat is known only as a fossil, whereas Geoffroy had an animal in the flesh. The fossil material of this bat was found associated with *Nesophontes*, *Phyllonycteris major* and *Monophyllus frater*, all known only as fossils, and with skulls of *Brachyphylla cavernarum* and other bats still living today. Geoffroy's type may very well have come from Porto Rico; on the other hand, *Stenoderma* may be extinct on Porto Rico and survive on some of the adjacent islands.

The relationships of *Stenoderma rufus* are well expressed by Miller's (1907, p. 165) treatment of the Stenoderminae. The affinities of the genus are with *Ardops* of the Lesser Antilles, *Phyllops* of Cuba and Santo Domingo, and more remotely with *Arctus* of Jamaica. Great diversity of development in the subfamily has taken place in the West Indies, specialization having run along different lines in separated localities. *Stenoderma*, in the character of its deeply excavated rostrum, is widely different from its most closely related neighbors, and in addition it possesses a well-developed metacouule in m^1 and m^2 which the other genera of the subfamily lack.

***Artibeus jamaicensis jamaicensis* Leach**

Text Fig. 11

See Miller: The Families and Genera of Bats, p. 160, 1907, for diagnosis of the genus.

- 1821. *Artibeus jamaicensis* Leach, Trans. Linn. Soc., XIII, p. 75.
- 1878. *Artibeus perspicillatus* Gundlach, Anales Soc. Espan. Hist. Nat., VII, p. 139.
- 1908. *Artibeus jamaicensis jamaicensis* Andersen, Proc. Zool. Soc. London, p. 265.
- 1911. *Artibeus jamaicensis* G. M. Allen, Bull. Mus. Comp. Zoöl., LIV, p. 234, July.
- 1912. *Artibeus jamaicensis jamaicensis* Miller, North American Land Mammals, p. 46, December 31.
- 1918. *Artibeus jamaicensis jamaicensis* Anthony, Indigenous Land Mammals of Porto Rico, p. 354, October 12.
- 1924. *Artibeus jamaicensis jamaicensis* Miller, North American Recent Mammals, p. 58.

Type locality.—Jamaica.

Distribution.²—"Central America and Southern Mexico, as far north as Morelos, and exclusive of Yucatan; St. Andrews and Old Providence Islands; Jamaica, Porto Rico, Santo Domingo, and Lesser Antilles as far east as St. Kitts."

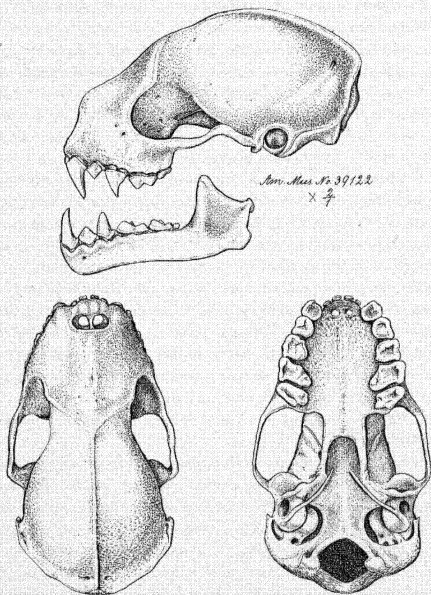


FIG. 11.—*Artibeus jamaicensis jamaicensis* $\times 2/1$; adult σ ; Utuado, Porto Rico

Recorded in Porto Rico from Cayey, Corozal, Lares, Morovis, Old Loiza, Pueblo Viejo, Quebradillas, San German, Trujillo Alto, Utuado; Aguas Buenas, Comerio, Hda. Catalina, Toa Alta (last four records of U. S. Biol. Survey).

Specimens collected.—47: Cayey, 1; Corozal, 5; Lares, 8; Old Loiza,

² Distribution from Miller (1924, p. 58).

1; Pueblo Viejo (Cueva de Fari), 1; San German, 14 (12 skins); Utuado, 17 skins.

General characters.—A large bat with robust body, narrow inter-femoral membrane and conspicuous nose-leaf. Head rather large; muzzle with large prominent lanceolate nose-leaf, arising from an enlarged nasal pad; upper and lower lips normal, well haired; ears short, separate, when laid forward lacking considerable of reaching tip of muzzle, tips rounded, posterior border passing into the basal conch by an abrupt shoulder; tragus large, wide, notched basally, thickened internally, sharp externally; body thick set; humerus proportionally short and heavy, furred throughout basal half; tibia and hind foot short, calcar present but very short; tail vestigial and not externally visible; interfemoral membrane narrow; membranes heavy and tough.

Color.—Adults: Above, nearly uniform, varying with the individual from warm sepia to light seal-brown, but with color of basal portion of pelage, ranging from light buff to pale smoke-gray, showing through on neck and shoulders to give those parts a lighter tone; below, uniform in coloration with upper parts, but hairs unicolor to the base except for limited area on under side of neck, where the hairs are buffy or gray basally, as above; facial stripes absent in most cases, but appearing faintly in some specimens, of same color as bases of the hairs on the upper side of the neck, the stripes running from the nose-leaf over the eye to the anterior border of the ear; membranes blackish brown; pelage rather thick, of medium length and very soft.

Young: Dark mouse-gray above and below, the hairs of the upper neck and shoulders lighter basally.

Skull.—Size large, strongly built; rostrum very broad and flat across nasals, external nares opening outward and upward; braincase progressively expanded posteriorly, dorsal outline strongly curved downward from parietals, sagittal crest well developed; mastoid process poorly developed; zygomatic arches strong, wide-spread, jugals nearly parallel to one another; palate broad, horseshoe-shaped; interpterygoid fossa U-shaped, reaching about half the distance from tips of pterygoid processes to plane of last molars; basisphenoid pits well developed; bullae slightly smaller than cochleae, combined auditory mechanism rather small; mandible strong and heavy, horizontal ramus straight and thick; ascending ramus broad, its ventral border in same plane with horizontal ramus; coronoid wide, triangular, much higher than condyle; angular process short, wide, rounded; dentition above and below heavy.

$$\text{Dentition.}—I, \frac{2-2}{2-2}; C, \frac{1-1}{1-1}; Pm, \frac{2-2}{2-2}; M, \frac{2-2}{3\ 3} = 30.$$

Upper: Incisors small, inner about twice size of outer pair, slightly separated from each other and from canines, inner pair with crowns slightly expanded laterally, cutting edge bilobed, outer pair with cutting edge oblique, entire; canine straight, simple, with internal cingulum: first premolar rather small, with sharp, anterior cusp, chisel-like cutting edge and poorly developed style; second premolar about twice as large as first, its main cusp the highest in the molar tooth-row, with broad, flat internal heel and low internal cusp; first molar with crown about twice as wide as long, with external cusps, paracone and metacone, and two low internal cusps, protocone and hypocone, the crown sloping abruptly downward from the external cutting edge to form a broad, internal basin, surface of crown covered with fine wrinkles; last molar slightly more than half as large as first, subelliptical in shape, with broad, wrinkled, crushing surface and postero-external cutting edge.

Lower: Incisors small, peg-like, with flattened crowns, cutting edges very faintly bifid, teeth crowded into intercanine space; canine simple: first premolar about half as high as second, with triangular, trenchant cusp; second premolar with one very high cusp and resembling considerably the canine: first molar large, about twice as long as wide, narrowed anteriorly, crown low with finely wrinkled surface; second molar subrectangular, much smaller than the first, with trenchant internal border bearing three low cusps; third molar minute, peg-like, closely crowded against second molar.

Measurements.—Average of 24 adults, both sexes: Total length, 107.2 mm. (100–115); hind foot, 17.5 (17–19); forearm, 58.88 (56–61.9).

Skull.—Average of 5 males and 5 females, adults: Greatest length, 28.47 (27.8–29); zygomatic breadth, 17.02 (16.5–17.7); interorbital breadth, 7.16 (6.7–7.4); breadth of braincase, 12.46 (12.2–13); length of palate, 12.65 (12.4–12.9); breadth of palate outside m^1 , 12.36 (12.1–12.8); length of maxillary molar series, 8.41 (7.9–8.8); length of mandible, 18.43 (18–19); length of mandibular molar series, 9.1 (8.6³–9.6).

Remarks.—The genus *Artibeus* has only one representative in Porto Rico and consequently there is little likelihood of confusion arising over the determination of this well-characterized species. The slight superficial resemblance which this species bears to *Brachyphylla cavernarum* is not misleading, for even a casual comparison of the two genera shows *Brachyphylla* to be larger, paler in color, and with a narrower rostrum, which lacks a well-developed nose-leaf. *Artibeus jamaicensis jamaicensis* has a very wide range and is found undifferentiated throughout the

³ In this specimen m_3 is lacking on both sides.

Greater Antilles, with the exception of Cuba. In Cuba, *Artibeus* is represented by another subspecies, *j. parvipes*, which differs from *j. jamaicensis* in slightly smaller size, smaller skull and smaller teeth.

This species is one of the most widely distributed of the Porto Rican bats. It was found in many localities widely separated and its range doubtless covers the whole island. It was always encountered in caves and, with one or two possible exceptions, when determination could not be made with certainty, was never seen flying at night. No especial preference for any particular type of cave was noticed, *Artibeus* being found in deep, dark caves and in shallow, light ones. It was often found in caves so shallow that there was very little protection from direct daylight, and bats of other species would not be present. It does not appear to be highly social and was generally scattered throughout a cave rather than in a single large colony. Numbers of the fibrous cores of native fruits were found lying on the cave floors where this fruit-eating bat had brought them.

The flight of *Artibeus* is rather heavy and steady in direction, when compared with some of the smaller species, although this bat is a strong, capable flyer. It is quarrelsome in disposition and vociferous when present in numbers. If given an opportunity, it is capable of making a painful wound, as its teeth are sharp and the jaw muscles powerful. It is not very easily alarmed and almost never left a cave when disturbed. Its call-note is a strong, strident squeak of harsh quality.

Females with small young were taken June 3 and gravid females with a single, large embryo were collected on the same day. On June 26 half-grown young were taken, and June 29 and July 1 young nearly the size of the adults were noted. The females carry the young when the latter are almost as large as themselves, and fly about with the heavy burden without much loss of speed.

Subfamily PHYLLONYCTERINAE

See Miller: The Families and Genera of Bats, p. 171, 1907, for diagnosis of the subfamily; p. 172, for diagnosis of the genus.

Phyllonycteris major Anthony

Text Fig. 12

- 1917. *Phyllonycteris major* Anthony, Bull. Amer. Mus. Nat. Hist., XXXVII, p. 567, September 7.
- 1918. *Phyllonycteris major* Anthony, Indigenous Land Mammals of Porto Rico, p. 356, October 12.
- 1924. *Phyllonycteris major* Miller, North American Recent Mammals, p. 62.

Type locality.—Cave near Morovis, Porto Rico.

The type is a skull nearly complete, but lacking full dentition; m^1 and m^2 on left side, m^2 and m^3 on right side are the only teeth present.

Distribution.—Known only from the Island of Porto Rico.

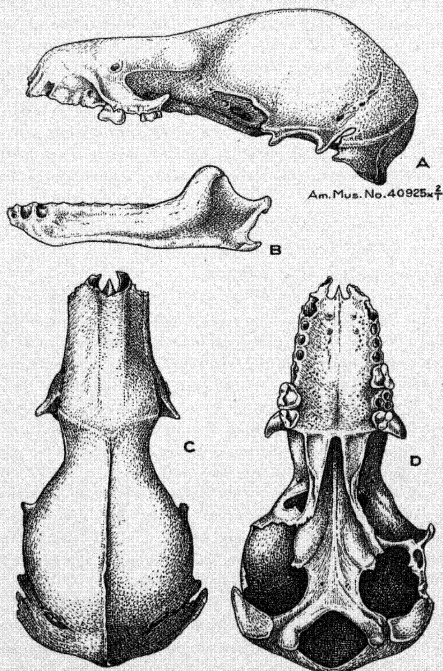


FIG. 12.—*Phyllonycteris major* $\times 2/1$; type; Morovis, Cueva Catedral, Porto Rico

General characters.—Closely related to *Phyllonycteris poeyi*, but noticeably larger, with wider braincase and heavier dentition.

Skull.—Rostrum long, deep and rather tubular, external nares opening slightly upward, nasals marked as flattened ridge along rostrum; inter-

orbital constriction very slight; braincase high and rounded, not rising abruptly from rostral plane, broader than deep, expanded posteriorly, very low sagittal crest; mastoid process poorly developed; zygomatic arch incomplete; palate very long, shallowly concave, narrowed anteriorly, small, incisive foramina present, pterygoid region very long, processes flattened, concave for half their extent; V-shaped interpterygoid notch not reaching plane of last molars; very low median ridge along floor of interpterygoid fossa; poorly developed basisphenoid pits; paroccipital processes well developed; bullae unknown; mandible (not particularly associated with type skull) long and narrow; horizontal ramus very straight, of good depth; ascending ramus scarcely elevated above horizontal ramus; coronoid high, wide, triangular; condyle much lower than coronoid, about level with molar crowns; dental foramen large and conspicuous.

*Dentition.*⁴—I, $\frac{2-2}{2-2}$; C, $\frac{1-1}{1-1}$; Pm, $\frac{2-2}{2-2}$; M, $\frac{3-3}{3-3} = 32$.

Dentition heavier than that of *P. poeyi*.

Upper: Incisors not present in any skull, but alveoli indicate incisors as in *poeyi*, a larger inner pair, a smaller outer pair, all in contact, but separated by diastema from canines; canine large, simple, with well-developed anterior and posterior cutting edges and narrow internal cingulum; first premolar small, subterete; second premolar rather more than twice as large as first, with single triangular cusp, practically no cingulum; molars with low crowns, not reaching level of crown of second premolar; first molar with crown about as broad as long, paracone and metacone scarcely distinguishable on the external cutting edge, internal crushing surface broad, outline from above subelliptical; second molar wider than long, the greatest length along external cutting edge, crown pattern of raised cutting edge with two cusps and broad, internal crushing surface; third molar about half size of second, crown flattened, subtriangular, the tooth set inside of extreme border of molar series.

Lower: Incisors not present but indicated as minute, subequal; canine large, with prominent posterior notch on cingulum; first premolar not known, but alveolus as large as that of second; second premolar with well-developed triangular median cusp; first molar with crown longer than wide, flattened, outline of cusps lost; second molar subrectangular, slightly longer than wide, crown flattened, with trace of shallow concavity, cusps very faintly indicated; third molar smaller than either first or second molars.

⁴ Description taken from type and topotype material.

Measurements of *Phyllonycteris*

	Greatest length	Inter-orbital breadth	Breadth of braincase	Breadth of rostrum at m ²	Length of palate	Breadth of palate inside m ²	Alveolar length of maxillary molar series	Length of mandible	Alveolar length of mandibular molar series
<i>Phyllonycteris major</i>									
40925*	26.7	5.5	11.3	7.8	10.7	4.5	6.7	.....	.....
40926	.....	5.9	.....	8.1	11.1	4.8	6.7	.....	.....
40927	27.2	5.5	11.1	7.6	10.7	4.5	6.8	.....	.....
40928	27.3	5.9	11.2	7.8	10.6	4.3	6.7	.....	.....
40929	28.1	5.7	11.4	8.2	10.7	5.	6.8	.....	.....
40930	27.7	5.6	11.	7.3	.....	5.	.....	.....	.....
40932	.....	5.7	11.3	7.6	.....	4.9	6.8	.....	.....
40933	.....	.....	.....	.....	.....	.....	.....	18.1	.....
40934	.....	.....	.....	.....	.....	.....	.....	17.6	8.3
<i>Phyllonycteris poepli</i>									
23758	25.7	5.2	10.5	7.3	10.5	4.5	6.1	16.	7.3
23759	24.7	5.3	9.9	6.9	9.7	4.3	5.7	15.4	7.2

* Type.

Specimens collected.—60 fragmentary skulls, only a few of which are nearly complete; 22 mandibles, mostly without any teeth, and small fragments not worth listing.

Remarks.—*Phyllonycteris major* is so obviously congeneric with *poeyi* that comparison elsewhere is unnecessary. From *poeyi* it may be told by its larger size, more widely expanded braincase and much larger second upper premolar.

This species was found only as a fossil and in but one cave. It was contemporaneous with *Nesophontes* as well as with *Stenoderma rufus* and other bats to be found living today. Possibly *P. major* may be found as a living bat, the chances for this being very favorable, since *P. poeyi* and the species of the related genus *Erophylla* occur only in isolated localities and escape notice for long periods, as witness the rarity, till recently, of *P. poeyi* and *E. sezekorni* in collections.

Heretofore, *Phyllonycteris*, with but a single species, has been known only from Cuba. The discovery of a closely related species of this peculiarly West Indian genus upon Porto Rico is an added bit of evidence in favor of an earlier, intimate connection between the now detached islands.

***Erophylla bombifrons* (Miller)**

Text Fig. 13

See Miller: The Families and Genera of Bats, p. 175, 1907, for diagnosis of the genus.

- 1899. *Phyllonycteris bombifrons* Miller, Proc. Biol. Soc. Washington, XIII, p. 36, May 29.
- 1906. *Erophylla bombifrons* Miller, Proc. Biol. Soc. Washington, XIX, p. 84, June 4.
- 1911. *Erophylla bombifrons* G. M. Allen, Bull. Mus. Comp. Zoöl., LIV, p. 240, July.
- 1912. *Erophylla bombifrons* Miller, North American Land Mammals, p. 51, December 31.
- 1918. *Erophylla bombifrons* Anthony, Indigenous Land Mammals of Porto Rico, p. 358, October 12.
- 1924. *Erophylla bombifrons* Miller, North American Recent Mammals, p. 63.

Type locality.—Cave near Bayamon, Porto Rico.

Distribution.—Known only from the Island of Porto Rico. Recorded from Bayamon and from the Cueva de Fari, near San Juan.

Specimens collected.—14: Cueva de Fari, Pueblo Viejo, 14 (8 skins), July 5 and 6.

General characters.—Size medium, ears simple, about as high as broad: tragus with notched edges; nose-leaf rudimentary, represented by a low,

pointed, median projection upon a naked, tumid nasal-pad; lower lip with median split; tail very short, terminal half free; interfemoral membrane narrow; calcar present but vestigial; skull moderately narrow and elongate; zygomatic arch complete; lower molars with distinct cutting edge.

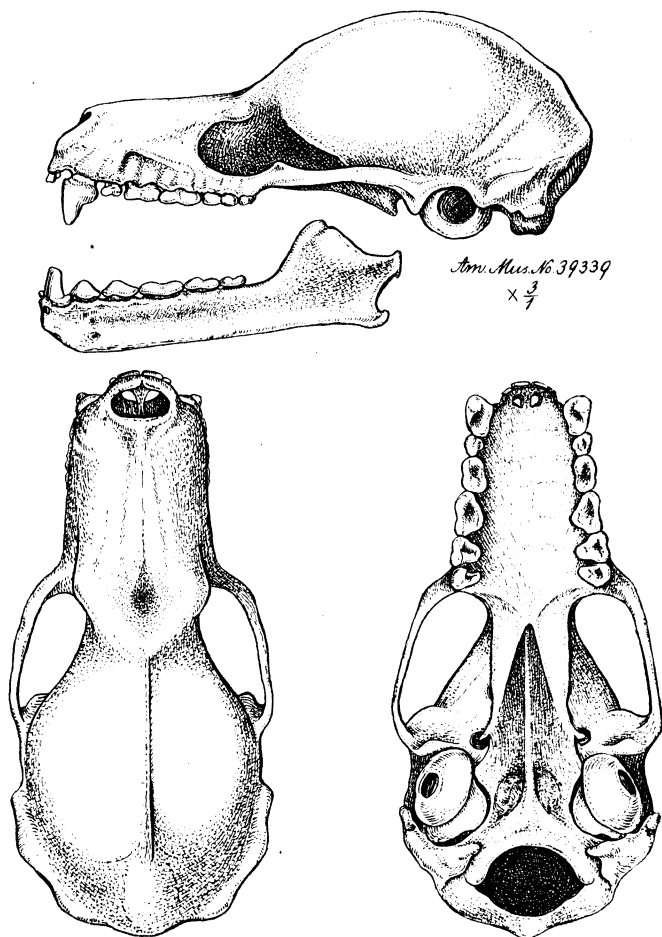


FIG. 13.—*Erophylla bombifrons* $\times 3/4$; adult σ ; Pueblo Viejo, Porto Rico

Color.—Adults: Above, hairs distinctly bicolor, being white for rather more than half the basal half, then tipped with chestnut-brown; from shoulders posteriorly the color is darker than on foreparts, where white of the basal part shows through; rather lighter on head and face, the

hairs unicolor and shorter; below, uniform wood-brown, the bases of the hairs whitish.

Young: Above, hairs white at base, clove-brown at tips, and coloration uniform over whole upper surface, white not showing through on neck as in adults; below, coloration scarcely lighter than above.

Skull.—Elongate, with fairly well-rounded and expanded braincase; rostrum long and with a marked concavity in the region of the nasal termination, rim of external nares thin and distinctly flaring; braincase rising abruptly from rostral plane; zygomatic arch complete; interpterygoid fossa very long; basisphenoid pits present; palate long and subrectangular; ramus very long and straight, coronoid low, condyle in plane of tooth-row, angular process well developed.

Dentition.—I, $\frac{2-2}{2-2}$; C, $\frac{1-1}{1-1}$; Pm, $\frac{2-2}{2-2}$; M, $\frac{3-3}{3-3}$ = 32. .

Upper: Inner incisors not meeting in midline, crowns expanded laterally, cutting edge broad, slightly bifid; outer incisors much smaller than inner, with oblique cutting edge in contact with neither canine nor incisors; canine large, dagger-like, with small internal cingulum; first premolar small and simple, with crown widened antero-posteriorly; second premolar much larger, with wide antero-posterior crown which has nearly smooth surface and outside border raised to form crescentic cutting edge; molars decreasing in size posteriorly; first molar nearly twice as long antero-posteriorly as wide transversely, outer border forming nearly flat cutting edge; second molar subtriangular across crown, cutting edge indented medially; third molar small, triangular, with straight cutting edge. All of the molar series very low crowned.

Lower: Incisors small, inner pair the smaller, not in contact, crowns expanded, cutting edges entire; canines large, with posterior cingulum; first premolar smaller than second, cutting edge on outer border, highest at middle; second premolar with a carnassial shearing edge; first molar with long, slightly concave cutting edge; second molar smaller than first, cutting edge more over central axis of tooth than on outside border and slightly depressed at middle; third molar smaller than second, cutting edge noticeably depressed at midpoint lying along central axis of tooth.

Measurements.—Average of 6 specimens: Total length, 81.6 mm. (80–85); tail vertebrae, 15.1 (13–17); hind foot, 16 (15–17); forearm, 48.6 (48–49).

Skull.—Average of 3 specimens: Total length 34.7 (34.3–34.9); zygomatic width, 11.83 (11.8–11.9); interorbital width, 4.5 (4.5–4.5); breadth of braincase, 10.1 (10–10.3); length of palate, 10.6 (10.4–10.7);

length of molar series, 6.27 (6.1–6.4); length of mandible, 16 (15.8–16.2); length of mandibular molar series, 7.8 (7.6–7.9).

Remarks.—There is no other Porto Rican bat liable to be confused with *Erophylla bombifrons*. In some characters this species has a superficial resemblance to *Monophyllus portoricensis*, but there are notable differences between the two in size, color and fundamental differences in tooth structure. From the other species of the genus to be found on other islands, *bombifrons* may be known by the combination of complete zygomata, high, rounded braincase rising abruptly above rostral plane, small teeth, notched tragus, and flaring rim of the external nares.

This brightly colored species was taken only in the Cueva de Fari, about two or three miles west of San Juan, and was noted in no other locality. It was found as a small colony, in a chamber to one side of the main cave, and there may have been about 35 or 40 animals altogether. After a few shots, the survivors flew out into other parts of the cave and were lost to observation. Their reddish appearance was apparent under the light of my acetylene lantern, and generally this species could be thus distinguished from the others found in the cave. *Erophylla* had segregated itself from the other species and was found in small potholes or concavities in the ceiling of the chamber, a few in each place. Young from two-thirds grown to nearly full grown were collected.

Family VESPERTILIONIDAE

See Miller: The Families and Genera of Bats, p. 195, 1907, for diagnosis of the family; p. 207, for diagnosis of the genus *Eptesicus*.

***Eptesicus fuscus wetmorei* (Jackson)**

Text Fig. 14

1916. *Eptesicus wetmorei* Jackson, Proc. Biol. Soc. Washington, XXIX, p. 37, February 24.
 1918. *Eptesicus fuscus wetmorei* Anthony, Indigenous Land Mammals of Porto Rico, p. 359, October 12.
 1924. *Eptesicus wetmorei* Miller, North American Recent Mammals, p. 78.

Type locality.—Maricao, Porto Rico.

Distribution.—Known only from the Island of Porto Rico. Recorded from Maricao (U. S. Biol. Survey), Cueva de Fari (Pueblo Viejo) and San German.

Specimens collected.—51: Cueva de Fari (Pueblo Viejo), 26 (11 skins); San German, 25 (10 skins).

General characters.—From specimens taken at San German. A medium-sized bat with tail completely enclosed in interfemoral membrane,

muzzle simple and color of fur brown. Nostrils simple, no nose-leaf. upper lip sparsely haired; lower lip simple; ears of moderate size, bluntly pointed, about reaching tip of muzzle when laid forward; tragus tall, slender, with rounded tip; body of normal proportions; humerus long, slightly bowed; digits normal, tibia of normal length, hind foot short. calcar long and heavy; tail long, completely enclosed in wide inter-

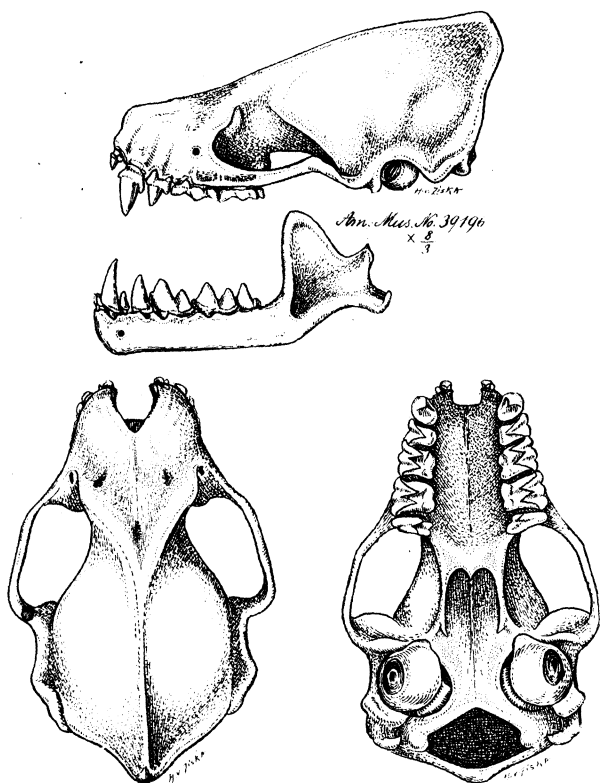


FIG. 14.—*Eptesicus fuscus wetmorei* $\times 8/3$; adult ♀; Pueblo Viejo, Porto Rico

femoral membrane; no fur anywhere on membranes; color above and below a warm brown, fur long and lax.

Color.—Adults: Above, everywhere a uniform mars-brown, the hairs blackish brown at the base; below, uniform clay-color; hairs blackish brown basally; membranes black. Individuals varying from the normal coloration as given were taken. The variants resemble very closely in color the immature pelage, although the animals are unquestionably adult.

Immature: Similar in color pattern to adults but differing in shade: above, bone-brown; below, tawny-olive.

Skull.—Moderate in size and normal in proportion of parts. Dorsal outline of skull nearly straight, a slight depression in nasal region; rostrum about as wide as long, very flat, external nares opening outward and upward; braincase moderately inflated through parietal region, flattened dorsally; noticeable sagittal crest; interorbital constriction somewhat pronounced; zygomatic flaring, greatest width posteriorly; mastoid reduced; palate long, moderately concave, cut away anteriorly between incisors to form a U-shaped indentation; bullæ of medium size, about as large as cochleæ; no basisphenoid pits; mandible normal; horizontal ramus straight; ascending ramus rising in gradual curve; coronoid very high and wide for a bat, much higher than condyle; angular process hook-like, very slightly deflected.

Dentition.—I, $\frac{2-2}{3-3}$; C, $\frac{1-1}{1-1}$; Pm, $\frac{1-1}{2-2}$; M, $\frac{3-3}{3-3} = 32$.

Upper: Incisors unequal, inner much larger than outer pair; inner incisors separated widely by the emargination of the palate and inclined slightly toward each other, crowns high, pointed, with small accessory cusp and poorly developed cingulum; outer incisors closely in contact with inner, but separated by slight diastema from canines, with single, well-developed cusp and external posterior cingulum; canine normal, with well-developed posterior cutting edge; premolar with high, trigonal cusp; first and second molars subequal, with W-shaped crown pattern of five cusps and connecting commissures and single, low internal cusp; third molar about half the size of anterior molars, with two cusps and a commissure of the W-pattern well developed, two cusps poorly developed and the fifth lacking entirely.

Lower: Three pairs of incisors subequal and similar in detail, closely in contact with canines and with each other, crowns spatulate with anterior cutting edge trifid; canine simple, with sharp postero-internal cutting edge and well-developed cingulum; first premolar about half as large as second, both first and second with a single cusp and well-developed cingulum; molars subequal, the third the smallest, all with five well-developed cusps.

Measurements.—Average of 15 adult females: In all the series collected there were no adult males suitable to be included in the series for measurement. Total length, 119.9 mm. (114-125); tail vertebrae, 48.3 (43-52); hind foot, 13 (12-14); forearm, 50.46 (48.2-51.3).

Skull.—Average of 10 skulls of adult females: Greatest length, 19.55

(19.1–20.2) ; zygomatic breadth, 13.16 (12.8–13.4) ; interorbital breadth, 4.26 (4.1–4.4) ; breadth of braincase, 8.59 (8.3–8.8) ; length of palate, 8.59 (8.4–8.8) ; length of maxillary molar series, 5.59 (5.4–5.7) ; length of mandible, 13.73 (13.3–14.1) ; length of mandibular molar series, 6.81 (6.7–7).

Remarks.—The long, lax fur and rich brown color of *Eptesicus fuscus wetmorei* are sufficiently diagnostic to mark it off from all the other bats. Its closest relative, perhaps, is *Eptesicus fuscus cubensis* of Cuba, type locality, Trinidad, Cuba, from which it differs but slightly. In the original description by Jackson, the Porto Rican animal is given full, specific rank. On the basis of the improbability of the actual intermingling of the Porto Rican form with the mainland *fuscus* or the Cuban *f. cubensis*, this determination is satisfactory, but on the basis of development and actual relationship the trinomial is the best expression. Examination of typical *fuscus*, *miradorensis*, *cubensis*, and *wetmorei* has convinced me that the relationship is a very close one, and to carry the expression of this relationship only to the limits of the mainland and then call the island forms full species hardly seems consistent. *Eptesicus f. wetmorei* bears especial resemblance to *f. miradorensis* from the Chiriqui region of Panama, having the same, well-built skull, heavy dentition and long forearm.

This bat was not noted throughout the island, but appeared to be restricted rather to the western half. In the two regions where it was taken it was a conspicuous bat, and were it generally distributed over Porto Rico it seems fair to assume more specimens would have been taken. Both at San German and at Pueblo Viejo it was found in caves, using deep crevices and holes in the limestone in much the same fashion as did *Tadarida*, being crowded into its retreats in large numbers. The several colonies located were nearly all females, and practically every animal was nursing or heavy with a single large embryo. This condition was noted June 6 and July 6, and while considerable variation in the development of the young bats was noticed, the majority of them were at about the same stage of development. At San German, June 6, most of the young were short-haired and about one-half the size of the parent. One of those taken proved to be a partial albino, differing from the others in its almost white coloration.

A bat seen at dusk in Lares was thought to be of this species.

A series of 9 skulls, some of which are nearly perfect, and one mandibular ramus of *E. f. wetmorei* were secured as fossils in the Cueva Catedral. These skulls appear to be indistinguishable from those of the living form, although associated with the skulls were skulls of genera

and species now extinct, the inference being that the deposit is older than the very recent.

Vespertilio maugei Desmarest

1819. *Vespertilio maugei* Desmarest, Nouv. Dict. d'Hist. Nat., XXXV, p. 480.
 1918. *Vespertilio maugei* Anthony, Indigenous Land Mammals of Porto Rico, p. 360, October 12.

This bat, said to have been brought from Porto Rico by Maugé, is described in sufficiently great detail to make its identification as one of the large-eared Vespertilionids certain. Very likely it is *Corynorhinus*, as the characters given by Desmarest fit this genus very closely, and Gray, in Cuvier's Animal Kingdom, vol. 5, 1827, p. 97, places it under *Plecotus*. This state of affairs gives plausibility to the hypothesis that Desmarest's specimen did not come from Porto Rico, since *Corynorhinus* has never been taken in the West Indies. Probably Maugé obtained his specimen from the mainland and, as was the case so often in the early days of systematic mammalogy, the describer confused the localities. For this reason I believe that *Vespertilio maugei* is not truly a Porto Rican record.

Family MOLOSSIDAE

See Miller: The Families and Genera of Bats, p. 241, 1907, for diagnosis of the family; p. 251, for diagnosis of the genus *Nyctinomus* = *Tadarida*.

Tadarida murina (Gray)

Text Fig. 15

1827. *Nyctinomus murinus* Gray, Cuvier's Animal Kingdom, Griffith edition, V, p. 66, paragraph 187.
 1861. *Nyctinomus musculus* Gundlach, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 149.
 1911. *Nyctinomus brasiliensis musculus* G. M. Allen, Bull. Mus. Comp. Zoöl., LIV, p. 244, July.
 1912. *Nyctinomus musculus* Miller, North American Land Mammals, p. 70, December 31.
 1918. *Nyctinomus murinus* Anthony, Indigenous Land Mammals of Porto Rico, p. 361, October 12.
 1924. *Tadarida muscula* Miller, North American Recent Mammals, p. 86.

Type locality.—Cuba.

Distribution.—Cuba, Jamaica, Santo Domingo and Porto Rico. Recorded in Porto Rico from Adjuntas, Cabo Rojo, Manati, San German and Utuado.

Specimens collected.—54: Adjuntas, 4 (3 skins); Cabo Rojo, 9 skins; San German, 35 (12 skins); Utuado, 6 skins.

General characters.—A small, free-tailed bat of dark-brown coloration. Head small; ears broad, not pointed, not united across forehead but arising from same point; tragus very small, subrectangular; antitragus low and rounded; muzzle well developed and without any excrescences except a few minute horny points on upper margin; scattered long hairs on face; upper lip with a number of transverse ridges; lower lip not peculiar; humerus long and nearly straight; wings very narrow; legs short;

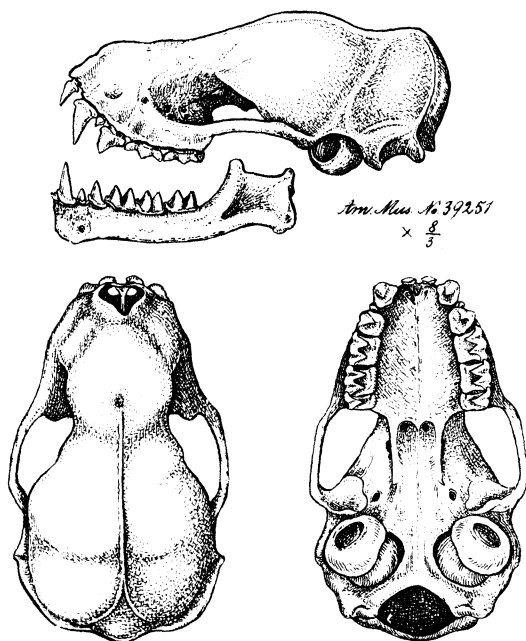


FIG. 15.—*Tadarida murina* $\times 8.3$; adult ♀; Utuado, Porto Rico

membranes fairly tough and leathery, not haired anywhere except for a few very short hairs on upper surface of interfemoral membrane and along median under surface of that membrane; long hairs on feet; tail free for about half of its length; color dark brown; fur soft and velvety.

Color.—Adults: Above, from warm Sepia to seal-brown, varying with the individual, the hairs light buff at the base and showing the lighter color more or less in the neck region; below, varying from cinnamon-brown to natal-brown, the hairs light colored at base as above; membranes blackish.

Skull.—Small, with dorsal outline nearly a straight line; rostrum fairly wide, rather flat and of normal length proportionally; interorbital constriction not excessive; braincase rounded but not globose, greatest inflation through parietal region, a constriction at region of supraoccipital and interparietal; no sagittal crest; zygomatic arch well developed, flaring but slightly; lachrymal and supraorbital ridges present; palate short and concave; interpterygoid fossa wide; basisphenoid pits hardly discernible; bulla and cochlea of moderate size; mandible normal with ramus curving slightly into ascending portion; coronoid sharp and deflected outward from plane of tooth-row; condyle slightly elevated above plane of tooth-row; angular process not conspicuously deflected from plane of lower border of ramus.

Dentition.—I, $\frac{1-1}{3-3}$; C, $\frac{1-1}{1-1}$; Pm, $\frac{2-2}{2-2}$; M, $\frac{3-3}{3-3}$ = 32.

Upper: Incisors inclined toward each other, but not meeting medially or filling up the intercanine space, crown surface long and oblique; canines sharp and simple, with practically no cingula; first premolar vestigial and visible only from outer side of tooth-row; second premolar large, with high anterior cusp and postero-internal basin; first and second molars equal, with W-shaped crown pattern of five cusps with connecting commissures and two additional cusps internally; third molar smaller, identical with second and third molars, but lacking the last ascending arm of the W and with only one internal cusp.

Lower: Incisors minute, subequal, crowns slightly expanded, bifid, the teeth completely filling space between canines; canine of moderate size with antero-internal accessory cusp and internal cingulum, first premolar about half size of second, simple in form, with single, sharp cusp; second premolar with high median cusp, the highest in molar tooth-row; second and third molars with normal pattern of five cusps; last molar slightly smaller but retaining the five cusps.

Measurements.—Average of 10 adults, 5 males and 5 females: Total length, 95.2 mm. (93–100); tail vertebrae, 33.8 (33–36); hind foot, 9.8 (9–10); forearm, 38.98 (38.2–40.1).

Skull.—Average of 10 adult skulls, 4 males and 6 females: Greatest length, 15.9 (15.6–16.2); zygomatic breadth, 9.25 (8.8–9.3); interorbital breadth, 3.78 (3.7–3.9); breadth of braincase, 7.7 (7.5–7.9); length of palate, 5.83 (5.6–6); length of maxillary molar series, 4.63 (4.5–4.8); length of mandible, 10.51 (10.2–10.7); length of mandibular molar series, 5.1 (5–5.3).

The name for the common *Tadarida* of the Greater Antilles has been

generally given by recent writers as *Nyctinomus musculus* Gundlach, 1861. This does not take into consideration the much earlier name of Gray. In *The Animal Kingdom of Cuvier*, published in 1827, Gray describes *Nyctinomus murinus* from a specimen in the British Museum, the habitat of which is Jamaica, queried, according to Redman. In the *Magazine of Zoölogy and Botany*, vol. 2, p. 501, 1838, Gray gives another description of this species and states its range as "South America, (Brasils); West Indies, (Jamaica)." Dobson, in his *Catalogue* (1878, p. 437), places *murinus* in synonymy with *N. brasiliensis* but lists among his specimens one from Jamaica as "Type of *Nyctinomus murinus* Gray." As Dobson had other specimens from Jamaica and was familiar also with *Nyctinomus macrotis*, the only other species of *Nyctinomus* known to occur on Jamaica, it seems fair to assume the validity of *murinus* and of the type locality as well. This being the case, Gray's name must stand for the small *Tadarida* generally distributed throughout the Greater Antilles, *musculus* being a synonym of it.

Lyon (1914, p. 217) has discussed the use of *Tadarida* for *Nyctinomus* and it seems best to make this change in generic terms.

Remarks.—*Tadarida murina* is not liable to confusion with any other Porto Rican bat with the exception of *Molossus fortis*. The distinctions between these two forms are fundamental: the high sagittal crest, the robust upper incisors completely filling up the intercanine space, the number of lower canines reduced to 1-1, and the curving dorsal outline of the skull of *Molossus* serving to show a well-marked generic separation, if the skulls are compared. Superficially, however, the differences are not so apparent, and as a rule it is necessary to have the bat in hand in order to determine whether it be *Tadarida* or *Molossus*. The best external characters to distinguish between the two are the following: *Molossus* is appreciably the larger and has noticeable strips of fur along the humerus which *Tadarida* lacks; it has ears that are much lower and thicker than those of *Tadarida*, a much narrower tragus and more prominent antitragus; males of *Molossus* have a gular gland; the upper lip of *Tadarida* is more tumid and has transverse wrinklins not to be seen in *Molossus*; and the fur of *Molossus* is darker in color, more velvety to the touch and much richer in appearance.

From the species of *Tadarida* to be found on the other islands of the West Indies, *murina* is distinguished as follows: from *T. antillarum* of the Lesser Antilles by the slightly smaller size of the latter; from *T. bahamensis* of the Bahamas by the larger size and grayer coloration of that form, and from *T. macrotis* of Cuba and Jamaica by the fact that *macrotis* belongs to that section of the genus which has 2-2 lower incisors.

This small bat is easily the best flyer of the island species. Its flight is very rapid and under such perfect control at all times that on occasion very erratic maneuvers are executed. This bat occupies much the same position among its fellows that the swifts do among the birds. The long, narrow wings give rapid strokes, and the bat rows through the air, oscillating from one side to the other, looking at a distance very much like a small swift. The compact, cylindrical form of the body, the long tail generally held out straight behind, so that the contour of the animal diminishes from the thickness of the body at the hips to the point of the tail behind, and the wings vibrating so rapidly that they often present a semi-transparent zone along the sides, all combine to give such a characteristic picture that this animal may be readily recognized on the wing, the closely related *Molossus* being the only other bat on the island with similar flight.

Tadarida murina is a dweller in both caves and houses, seeming to be one of the most abundant bats on the island. Old buildings frequently had bats to the number of several hundred spending the day packed into dark crevices. In caves these bats chose deep fissures or holes in the limestone and were packed in very closely. When disturbed they poured forth literally in a stream. The large piles of droppings beneath such holes demonstrated the fact of the great concentration in numbers. In no case was *Tadarida* ever found in small, scattered groups, the social instinct seeming to bring all of the individuals of a region into large congregations. The habit of the sexes of keeping in separate colonies is very marked. This species has a sharp, high-pitched squeak and is rather noisy when in large numbers.

A very large colony was located in an old, deserted building in San German. It was a typical old Spanish structure of low, rambling construction, made of brick and wood and with an inner court. In places it was more or less fallen in. Early in the evening, about 6:45, we entered the building and were greeted by a great deal of squeaking from the many dark corners. The noise was made by so many individuals that it seemed as if we stood in a gigantic beehive, and this squeaking buzz could be heard even before the door was opened and the building entered, showing that the bats were beginning to stir about, preparatory to issuing forth for the night. By seven o'clock, bats were flying about the darkened corridors and rooms in small numbers. Very shortly they began to come forth in large numbers, and the interior was teeming with the noisy animals on the wing. Soon the bats left the interior and began to leave by way of the inner court, which took on the appearance of a whirlpool of bats. Issuing from the rooms, they circled the court, all

going in one direction and at a high rate of speed. A few passed up and over the enclosure at the completion of each lap, until finally none were left. The whole building had the pronounced musky odor seemingly characteristic of the Molossidae. *Tadarida* seen in other localities showed a tendency to circle for several moments about the spot where it had spent the day before straightening out the flight and taking a direct course for other feeding grounds.

Females taken June 7, 11 and 24 contained single, large embryos nearly ready for birth. No immature animals flying with the adults were taken. At San German, during early June, this bat was frequently seen to reënter the home crevice after having been awing about thirty minutes: possibly this was for the purpose of nursing the young.

***Molossus fortis* Miller**

Text Fig. 16

See Miller: The Families and Genera of Bats, p. 260, 1907, for diagnosis of the genus.

1878. *Molossus obscurus* Gundlach, Anales de Historia Natural, VII, p. 140.

1913. *Molossus fortis* Miller, Proc. U. S. Nat. Mus., XLVI, p. 89, August 23.

1918. *Molossus fortis* Anthony, Indigenous Land Mammals of Porto Rico, p. 363, October 12.

1924. *Molossus fortis* Miller, North American Recent Mammals, p. 89.

Type locality.—Luquillo, Porto Rico.

Distribution.—Known only from the Island of Porto Rico. Recorded from Luquillo (U. S. Nat. Mus.), Adjuntas, San German, Utuado, Aibonito and Mameyes (last two records of U. S. Biol. Survey).

Specimens collected.—33: San German, 2 skins; Adjuntas, 27 (20 skins); Utuado, 4 skins.

General characters.—A small, free-tailed bat with dark pelage; head small; ears low, the joining membrane thick, meeting on forehead; tragus very small, antitragus thick and rounded; nostrils slightly tubular; a few stiff hairs between ears and nostrils and on upper lip; lower lip not peculiar; humerus moderately curved; wings long and exceedingly narrow; tail free for about half its length; interfemoral membrane not extensive; feet with conspicuous long hairs on the tarsals and metatarsals; fur short, soft and velvety; gular gland on males; narrow strips of fur on humerus, above and below, and fur of body extending onto lateral membranes for short distance.

Color.—Adults: Above, varying with the individual from Vandyke-brown to clove-brown, the hairs white for the basal half; below, same

color as above, but fur shorter and white basal portion showing more; membranes blackish.

Young: Pelage very short and thick; about chaetura-black; below, deep mouse-gray.

Skull.—Skull small, but not especially delicately constructed; rostrum very short, expanded anteriorly, external nares opening upward as well as outward; braincase expanded laterally, flattened on superior surface;

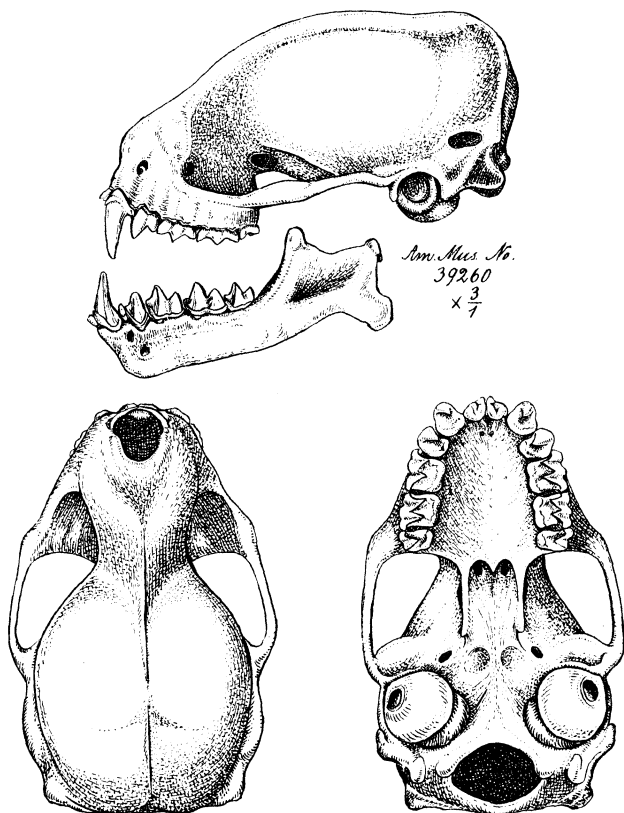


FIG. 16.—*Molossus fortis* $\times 3/1$; adult σ ; Adjuntas, Porto Rico

high knife-like sagittal crest extending from just anterior to the greatest interorbital constriction back to the lambdoidal crest, and higher in males than in females; lambdoidal crest high and thin; zygomatic arches flaring very slightly; bullae nearly as large as cochleae; jugal straight; palate short, concave, narrowing slightly anteriorly; interpterygoid fossa very wide; basisphenoid pits deep and prominent; mandibles of medium length, forming a triangle of approximately equal sides; ramus deepened

anteriorly, straight to last molar, then curved gently up into ascending ramus; coronoid a sharp, outwardly deflected process; angular process large and strongly curved outward.

$$\text{Dentition.}—I, \frac{1-1}{1-1}; C, \frac{1-1}{1-1}; Pm, \frac{1-1}{2-2}; M, \frac{3-3}{3-3} = 26.$$

Upper: Incisors large, strongly in contact medially and approximating contact with the cingula of the canines, crowns subtriangular, with high cone on the anterior internal angle; canine with anterior and posterior internal cutting edges and a cingulum; premolar wider than long, with a high, sharp cusp anteriorly and a deep, internal concavity posteriorly; first and second molars with the typical W-shaped pattern and the inner part of the crown filled up by a large protocone; third molar representing in most details half of an anterior molar.

Lower: Incisors minute with laterally expanded crowns, cutting edge blid, in contact medially, but crowded forward from the normal position between canines; canines large, the cingula meeting in the midline, an internal anterior accessory cusp on the cingulum; first premolar small, very closely crowded by second premolar, very narrow antero-posteriorly; second premolar with high antero-median cusp and low postero-internal cusp; the three molars subequal, third the smallest, each with 5 cusps and connecting commissures to form a discontinuous W-pattern, the discontinuity due to the absence of the full number of commissures as found in the upper molars.

Measurements.—Average of 10 males: Total length, 111.3 mm. (104–118); tail vertebrae, 40.1 (35–46); hind foot, 10.9 (10–12); forearm, 39.15 (38.5–40.2). Average of 10 females: Total length, 108.3 (100–111); tail vertebrae, 37.8 (35–41); hind foot, 10.8 (10–11); forearm, 38.75 (37.5–40.2).

Skull.—Average of 10 skulls, 5 males and 5 females: Greatest length, 17.38 (16.9–18.2); zygomatic breadth, 10.7 (10.2–11.3); interorbital breadth, 3.61 (3.4–3.7); breadth of braincase, 8.72 (8.5–9.1); length of palate, 5.34 (5–5.7); length of molar series, 5.07 (5–5.2); length of mandible, 11.46 (11.2–12); length of mandibular molar series, 6.01 (5.9–6.2).

Remarks.—There is only one species of *Molossus* on Porto Rico, and consequently *fortis* needs no specific comparison with any of its immediate neighbors. A very close, superficial resemblance exists, however, between the small members of the related genera, *Molossus* and *Tadarida*, and as *Tadarida murina* is found on Porto Rico care must be taken in distinguishing the two. The characters of distinction have already been

given in the treatment of *Tadarida murina*. From the related species of *Molossus*, the Porto Rican *fortis* is distinguished by the combination of the following characters: moderate size (forearm, 40 mm.), rostrum not heavy, color dark and molars of normal size.

In addition to the localities recorded under the distribution, this bat was noted at Lares and at the Preston Ranch near Naguabo, but no specimens were taken. Because of the impossibility of distinguishing between *Molossus* and *Tadarida* when on the wing and in a poor light, definite records are given only when specimens were collected or the opportunities for observation were unusually good. *Molossus fortis* appears to be quite well distributed over the island, although I have no notes for it in the San Juan district. It was not found anywhere in caves and probably is almost strictly an inhabitant of old dwellings, which are sufficiently numerous in Porto Rico to afford ample quarters. For this reason it was not as easy to collect, as it was often impossible to shoot about the buildings, and in the case of old church buildings the high ceilings where the bats were in hiding were inaccessible.

The flight of this bat is exceedingly swift and erratic and possibly it is an even more skillful aviator than *Tadarida murina*. The flight of these two forms is so essentially identical and the size difference so slight that there is little to mark off the one from the other.

This bat comes forth while there is yet considerable daylight, and by early dusk, if there is any large colony of bats in a town, a multitude of the little animals will be seen pursuing their zigzag courses about the streets. In the month of June the first bats would begin to appear about 4 p. m. In a quarter of an hour the number would greatly increase and probably the total bat population would be awing by 7:30. This bat was frequently seen leaving the eaves of some house in the evening and one could not fail to be impressed by the intense activity of the small creature. The bat would drop out from the opening and take a downward course for five or six feet, then straightening out in the most rapid flight. Often one could see the head of the bat appear an instant before the animal precipitated itself headlong, but so quick were the movements that it was exceedingly difficult to shoot the bat, even when thus warned to expect its emergence. Not infrequently the animal was not observed until it appeared as if shot out from the opening in full flight.

A large colony was located in the attic of the lodge building at Adjuntas. It was possible to ascend into the attic and by poking into the crevices between the rafters dislodge the bats. This species is not very dormant, even in midday, and it was not an easy task to dislodge them. A nose and pair of bright eyes would peer out of a crack with a very

mouse-like aspect and the owner would dodge back so nimbly as to avoid all thrusts of the stick. Tobacco smoke blown into a long crevice demoralized the tenants and they attempted to move into adjacent nooks with much scuffling and scratching, accompanied by sharp squeaking. When animals were knocked down to the floor, if uninjured, they ran for dark corners with as much agility as a mouse. This bat always attempts to bite if given the opportunity. An intensely musky odor was always to be noted about the buildings where *Molossus* stayed.

Order INSECTIVORA

Family NESOPHONTIDAE

1916. Nesophontidae Anthony, Bull. Amer. Mus. Nat. Hist., XXXV, p. 728.
 1923. Nesophontini Winge, Pattedyr-Slaegter, I, p. 123 (under family Talpidae).
 1924. Nesophontidae Miller, North American Recent Mammals, p. 9.

Nesophontes Anthony

1916. *Nesophontes* Anthony, Bull. Amer. Mus. Nat. Hist., XXXV, p. 725, November 16.
 1918. *Nesophontes* G. M. Allen, Bull. Mus. Comp. Zoöl., LXII, p. 135, May.
 1918. *Nesophontes* Anthony, Indigenous Land Mammals of Porto Rico, p. 365, October 12.
 1923. *Nesophontes* Winge, Pattedyr-Slaegter, I, pp. 123, 148.
 1924. *Nesophontes* Miller, North American Recent Mammals, p. 9.

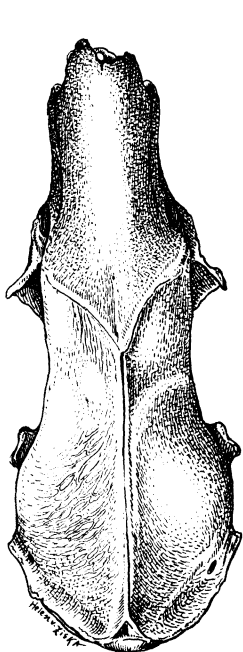
Type.—*Nesophontes edithae* Anthony.

Insectivores of medium size with nearly the full primitive dentition;

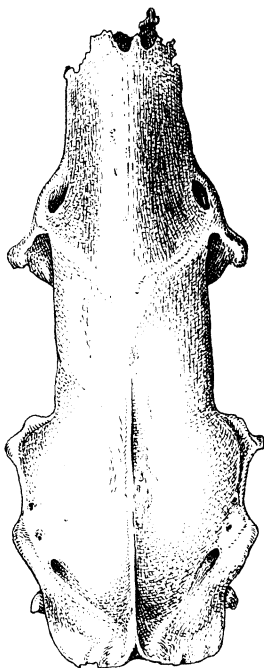
$$I, \frac{3-3}{3-3}; C, \frac{1-1}{1-1}; Pm, \frac{3-3}{3-3}; M, \frac{3-3}{3-3} = 40.$$
 Incisors smaller than canines, simple, and with median diastema above; canines dagger-like, two-rooted, in normal position; upper molars triangular in cross-section, with V-shaped protocone, metacone and paracone;⁵ lower molars of primitive tuberculo-sectorial type; zygomatic arch incomplete, lacking malar; skull elongate and narrow, basicranial region moderately elongate antero-posteriorly.

Distribution.—Known only from Porto Rico, Cuba and the Isle of Pines.

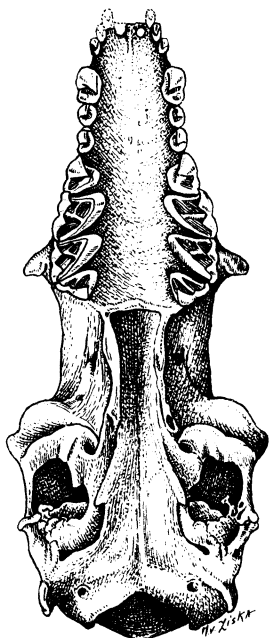
⁵ The type specimen has worn molars and the paracone has been almost obliterated, a condition which led to an error in the diagnosis of the family, 1916, l. c., when it was stated that the *Nesophontes* molar had no paracone. The available material, however, demonstrated that the unworn molar possesses the full complement of primary cusps. Unfortunately, the diagnosis of the family, as given in the more detailed report of 1918, repeated the misstatement as to the paracone, through a *lapsus*, although the presence of the paracone was implied in other statements made in the same discussion (p. 378). The figure of No. 17096, palatal view, also indicated the presence of the paracone.



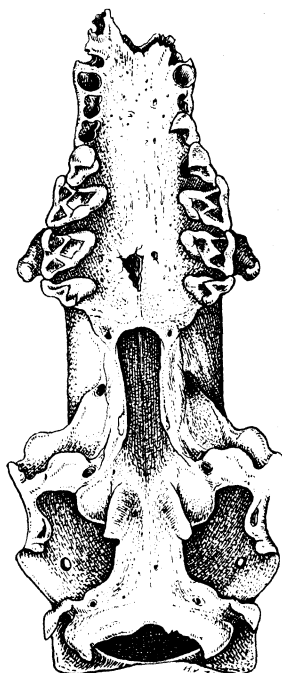
Am. Mus. No. 14174 ♀ × $\frac{2}{7}$



Am. Mus. No. 17096 ♂ × $\frac{2}{7}$



No. 14174 ♀ × $\frac{2}{7}$



No. 17096 ♂ × $\frac{2}{7}$

FIG. 17.—*Nesophontes edithae* × 2/1. Skulls of adult male and adult female from Cueva Catedral, Morovis, Porto Rico

Nesophontes edithae Anthony

Text Figs. 17-28, Plates XIII-XV

1916. *Nesophontes edithae* Anthony, Bull. Amer. Mus. Nat. Hist., XXXV, p. 725, November 16.
 1918. *Nesophontes edithae* Anthony, Indigenous Land Mammals of Porto Rico, p. 365, October 12.
 1924. *Nesophontes edithae* Miller, North American Recent Mammals, p. 9.

Type.—No. 14174, Dept. Vert. Pal., Amer. Mus. Nat. Hist. The type is a skull in nearly perfect condition, being broken only at the extreme tip of the premaxillaries and lacking the auditory bullæ, dentition well worn.

Type locality.—The type, as well as a large number of other skulls of this insectivore, was taken from a cave near Morovis, Porto Rico. This cave is more or less well known locally as the Cathedral Cave, "Cueva Cathedral."

Distribution.—Known only from Porto Rico. Recorded from Porto Rico from Hacienda Jobo (near Utuado), Utuado and Morovis (Cueva Clara and Cueva Cathedral).

Skull.—(Text Figs. 17, 18.) Males have skulls considerably larger than those of females, although proportionally the skulls of both sexes are practically identical.⁶

Skull elongate and narrow, tapering gradually in width from parietals to end of nasals, superior outline nearly straight, slightly elevated in fronto-parietal area; rostrum long, tubular, and strongly convex from side to side, only slightly narrower outside incisors than at base of zygomatic roots, much deeper than wide; nasal sutures not satisfactorily discernible because of fusion, but apparently nasals are very narrow; inter-orbital region with sides practically parallel, in males a very slight widening anteriorly, this whole region flatly convex from side to side; braincase only slightly inflated, parietals swollen, but interparietal and supraoccipital regions somewhat constricted, inflation generally more noticeable in females than males; very low sagittal crest, higher in males, ending anteriorly in noticeable supraorbital ridges; lambdoidal crest well developed, especially in males; noticeable fine wrinkling of bone surface over upper part of braincase (best shown in type, a female).

Zygomatic arch incomplete, lacking jugal, anterior root a peg-like process, posterior root a blunt process upon the expanded glenoid; infra-

⁶ The series of crania is divisible into two groups, on the basis of size only, and the most logical way to account for this is by assuming a sexual dimorphism. No such sex difference in size is known among living insectivores, but the occurrence of two similar groups in the series of Cuban *Nesophontes* strengthens the impression that the size difference is not inter- but intra-specific.

orbital foramen very large, lachrymal canal of good size; mastoid process well developed.

Palate long, laterally concave, almost parallel-sided, with a pair of small incisive foramina, and terminating just posterior to last molar in

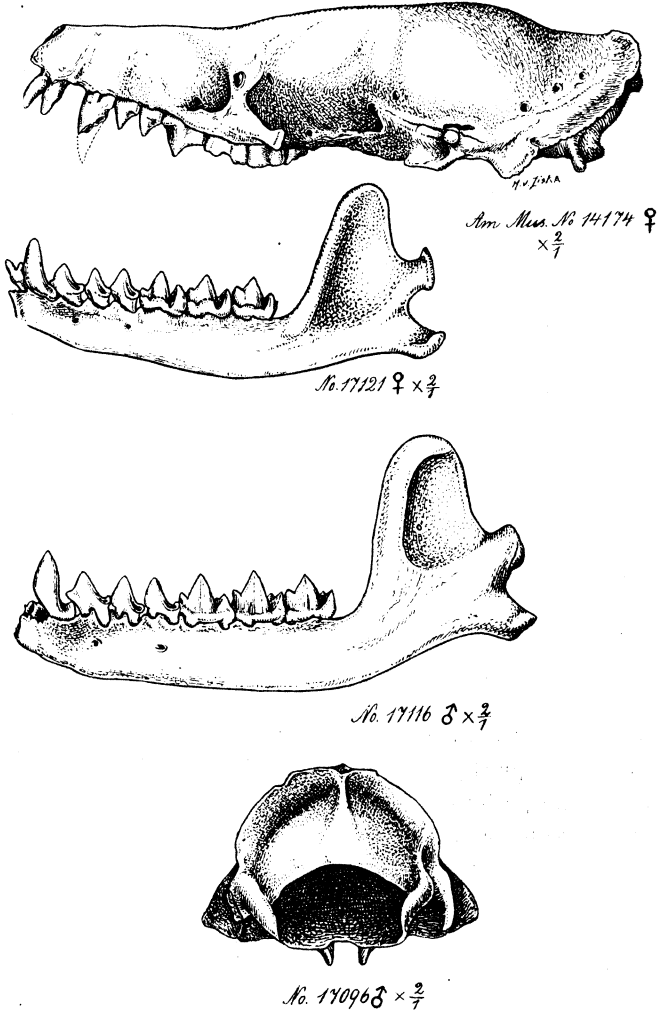


FIG. 18.—*Ncsophontes edithae*. Skulls of adult male and adult female from Cueva Catedral, Porto Rico. $\times 2/1$

a square, postpalatal notch; palate completely ossified, but very thin and often with four distinct, transverse, arcuate rows of minute pores or foramina; pterygoid processes well separated, low, terminating in small

hook-like process at their highest points before they slope gradually to meet the floor of the alisphenoid; pterygoid fossa reduced to shallow concavity; basicranial region of good length, not compacted; basisphenoid with a pair of sharp ridges bounding basisphenoid pits; glenoid with concavity facing almost directly front instead of customary ventral position, due to extreme development of the postglenoid process; the petrosal is small, with a flattened anterior and rounded posterior face, and a short, thick posterior external wing that attaches to the tympanic; the tympanic is ring-shaped, nearly circular, and placed transversely, with only a slight posterior obliquity; it is closely appressed to the petrosal and is separated by a considerable interval from the postglenoid process; neither alisphenoid nor basisphenoid enter into the auditory structure; paroccipital process well developed; condyle large; foramen magnum very large.

Mandible very strong and heavy; horizontal ramus with lower border convex, deep and thick, deepest at m_1 and m_2 ; posterior mental foramen below the last premolar; ascending ramus with lower border continuing in the curve of horizontal ramus, angular process large, falciform; coronoid process large and high, with muscle insertion areas prominently marked; condyle with articulating surface facing obliquely backward.

$$\text{Dentition.}—I, \frac{3-3}{3-3}; C, \frac{1-1}{1-1}; Pm, \frac{3-3}{3-3}; M, \frac{3-3}{3-3} = 40.$$

(Text Figs. 18, 19, 20.)

Upper: Incisors arranged in nearly parallel rows, the teeth of each row closely in contact with one another, but the anterior incisors of each row separated from each other by a diastema equal to about half the width of the palate from canine to canine; first incisor the largest of the three, about three-quarters as high as canine, with slightly convex anterior outline, and posterior outline with shallow notch or shoulder about half-way up; second and third incisors subequal, simple in structure, without any posterior notch, but a noticeable posterior cingulum; all three incisors have flattened internal faces giving anterior and posterior cutting edges; all are slightly procumbent, the greatest procumbency being found in the first incisor; a distinct diastema between incisors and canines; canine double-rooted, large, strong, piercing, much the highest tooth in the entire row except for first incisor, which approximates it; anterior face flat, with longitudinal groove, well-developed anterior and posterior cutting edges; internal face flat, with conspicuous median longitudinal groove; posterior face slightly convex, a noticeable posterior notch at base of tooth in the position of cingulum; first two premolars

subequal, with simple trigonal cusps and poorly developed postero-internal cingula; third premolar submolariform, its single trigonal cusp the highest of molar series, with low internal heel and postero-external shoulder; first two molars subequal, with crown roughly triangular in outline, well-developed protocone and metacone as trenchant V-shaped

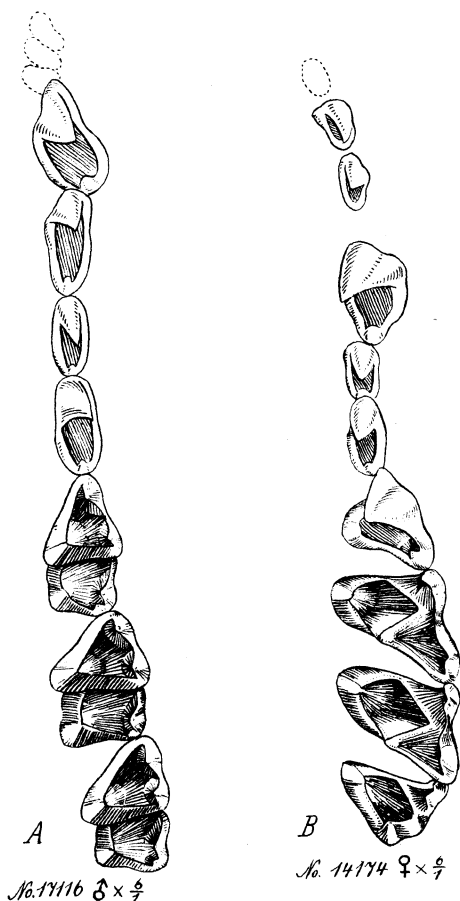


FIG. 19.—*Nesophontes edithae*. Crown views of upper dentition, A, and lower dentition, B. $\times 6/1$

cusps; paracone much smaller than either protocone or metacone, low para- and metastyles; third molar slightly more than half as large as second, which it closely resembles except for loss of corner of tooth bearing metastyle; protocone well developed, metacone not as well developed as in m^2 , parastyle present.

Lower: Incisors not all present in any mandibles found, but alveoli show that the three are small, closely in contact and the rows meeting at the mandibular symphysis; third incisor reaching about midway up canine, cutting edge broadly bilobed and entire face of tooth greatly expanded, a wide sulcus down inner face of incisor; canine strong and

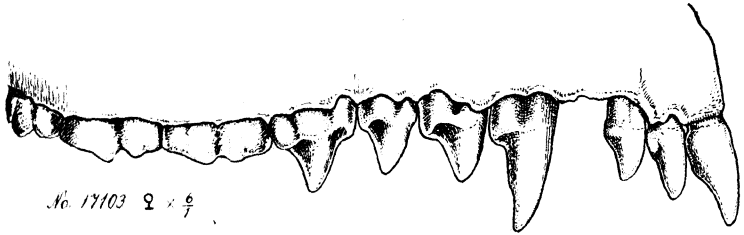


FIG. 20. —*Nesophontes edithae*. Upper dentition in profile. $\times 6/1$

much higher than any other tooth of mandible, with an anterior cutting edge the outline of which is convex; the internal face, passing from apex to root, seems to rotate to the rear, so that canine appears as if twisted from right to left; this rotation further expressed by appearance of external and posterior faces of canine, a narrow shoulder developed at base of posterior face; three premolars subequal, with trenchant triangular cusps and narrow heel; three molars of approximately equal size, all with high tuberculo-sectorial trigonid and broad, flat talonid, the protoconid being the highest cusp.

In a mandible (No. 17115) showing evidences of early maturity what appears to be the permanent canine can be seen pushing up against its milk predecessor, which is subpremolariform in shape.

Skulls collected.—97, of which many are nearly complete, lacking only incisors and bullae.

Mandibles collected.—70, the greatest number lacking only the incisors; also, a considerable number of fragmentary skulls and rami too badly broken to be worth listing separately.

Remarks.—Three species of the genus *Nesophontes* have been described—*edithae* of Porto Rico, *micrus* of Cuba and *longirostris*, also of Cuba. *Edithae* is very much larger than either of the two Cuban species. In addition to the size difference, there are cranial distinctions which have been set forth in detail by Anthony (1919, p. 633). *N. micrus* has the first anterior upper premolar noticeably larger than the second, whereas in *edithae* the anterior upper premolars are equal. *N. longirostris* has a distinct diastema between canine and first premolar above, between the two anterior premolars, and between the second and third premolars.

Measurements of Skull of *Nesophontes edithae*

Catalogue No. of Department of Vertebrate Palaeontology	Greatest length	Greatest breadth across zygomatic roots on squamosal	Greatest breadth of brain-case	Least inter-orbital breadth	Breadth of rostrum just behind canines	Length of palate, post-palatal notch to posterior border incisive foramina	Breadth of palate at pm ⁴	Length of maxillary molar series	Catalogue No. of Department of Vertebrate Palaeontology	Length of mandible	Length of mandibular molar series
♂											
17094		18.6	15.9	10	7.4	18.9	5.2	15.2	17116	34	17.6
17095				10	7.6		5.2	14.2	17117	31.5	15.8
17096		18.9	15.8	10.3	8.1		5.5	15	17118	34.3	17
17109		19	15.7	10.2			5.5	15	17119	32.6	16.1
17111		18		9.8	6.8	18.5	4.7	14.6	17120	31.6	16.1
17112		19			7.8		5.4	16			
17114	44.2?		15.9	9.5	7.4		4.7	12.9			
♀											
17097				9.2	6.9		4.5	12.9	17121	28.5	14.5
17098	40.3	16.2	14.5	9.1	6.8	17.3	4.6	13	17122	27.6	13.6
17099	41.2	16.9	15.2	9.3	6.8	17.5		13.4	17123	27.9	14.2
17100	38.6	16	13.7	9.2	6	16.5	3.9	12.2	17124	28.1	14
17103			14.4	9	6.1	16.2	4	12	17125	28.2	13.5
17104	39?	16	14.6	8.7	5.7	15.4	4.5	12.5	14174	27.8	13.5
17106		16.1	14.2	9.5	6.9	17.2	4.1	12.6			
17107	40.7	16.2	14.2	9.2	6.7	16.2	4.5	12.8			
17108	40.8?	16.5	14.3	9.2	6.6		4.3	13.2			
17110	40.2?	16.1	14.3	9.1	6.3		4.7	13.4			
17174*	41	17	14.5	8.5	6.5	17	4.4	12.5			

* Type.

The Skeleton of *Nesophontes edithae*

The scapula (text Fig. 21) is long and has a breadth equal to about half its length. The spine is very high, the acromion and metaacromion are well developed and the coracoid is very long and strongly curved. The axillary border is reflected outward to produce a ridge and a deep concavity paralleling the spine. The anterior superior border is smooth and regular.

Scapulae collected.—Parts of seven scapulæ, of which three are fairly well preserved and afford between them all the different structures.

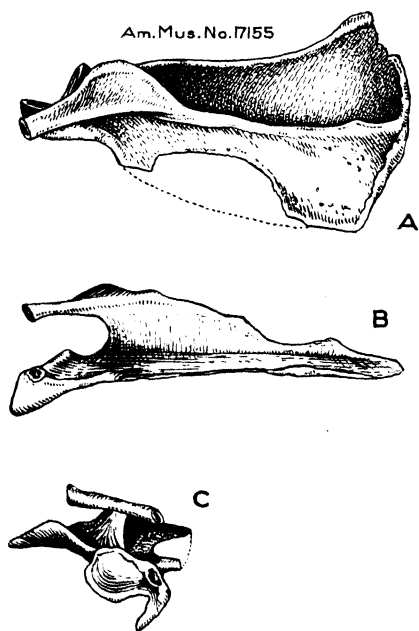


FIG. 21. *Nesophontes edithae*. Right scapula: A, external aspect; B, anterior aspect; C, ventral aspect. $\times 5\frac{1}{2}$

Measurements.—Composite of scapulæ, all males. Length over all, 19.8 mm.; greatest width, 11.3; greatest depth, through acromion, 4; width of neck, 3.4; transverse width of glenoid, 2.4; glenoid + coracoid, 4.5.

If the *Centetes* scapula be taken as a primitive type, the *Nesophontes* scapula is seen to be rather more advanced in several details. The reflection of the axillary border and the extreme development of the acromial and coracoid processes are not found in the *Centetes* scapula, while the spine is much deeper in the case of *Nesophontes*. A close approxi-

mation to *Nesophontes* is noted in *Solenodon*. Proportionally, *Nesophontes* has carried the development of the spine further, and the constriction of the body of the bone at the neck is much more marked. *Nesophontes* does not have the posterior superior border drawn out into a sharp point, as in *Solenodon*. Probably as close agreement is shown by the *Crocidura* (*Crocidura nyansue kiru*) scapula, where the same deep, partially enclosed, infra-spinatus fossa is found. The same expansion of the spine in the acromial region does not occur in the *Crocidura* scapula. The *Gymnura*, and to a lesser degree the *Erinaceus*, scapula resembles the *Nesophontes* scapula in most of the primitive details. *Nesophontes*

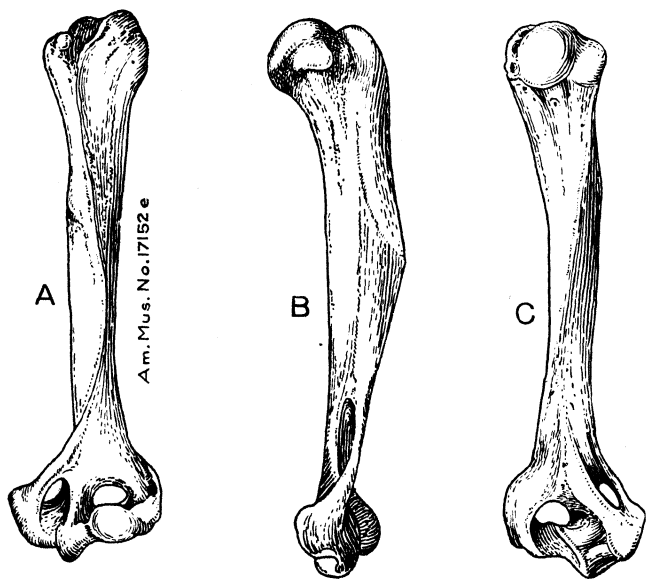


FIG. 22.—*Nesophontes edithae*. Left humerus: A, anterior aspect; B, internal aspect; C, posterior aspect. $\times 5/2$

does not very closely parallel *Tupaia* in details of the scapula, although they have the reflected axillary border in common.

The humerus (text Fig. 22) of *Nesophontes* is nearly straight, rather robust, and with a conspicuous deltoid ridge. It is expanded distally and the shaft above the expansion is rather slender. The head is large and broadly elliptical in cross-section; the bicipital groove is well marked and the greater and lesser tuberosities are well developed. Moderate-sized entepicondylar and supratrochlear foramina are present. The supinator crest is an arcuate ridge which extends onto the unexpanded shaft. There is a conspicuous swelling on the internal aspect of the

deltoid ridge to mark the attachment area of the *teres major* and *latissimus dorsi*.

Humeri collected.—135, most of them perfect.

Measurements of Humerus of Nesophontes edithae

	Greatest length	Greatest width distally	Least width of shaft	Greatest depth through deltoid ridge	Transverse width of head from bicipital groove
♂					
a.....	26.1	6.9	1.9	3.1	4.2
b.....	26.0	6.8	1.9	3.8	4.1
c.....	27.7	7.2	1.9	3.5	4.3
d.....	26.9	7.0	1.8	3.4	4.1
e.....	26.8	7.2	1.8	3.6	4.3
♀					
f.....	22.7	5.7	1.6	3.3	3.7
g.....	23.7	6.2	1.4	3.2	3.6
h.....	22.5	5.5	1.5	2.9	3.5
i.....	22.6	5.8	1.5	3.1	3.6
j.....	22.5	5.3	1.5	2.9	3.3

The humerus of *Nesophontes* bears considerable resemblance to that of *Solenodon*, but is even more primitive than the latter, retaining an unspecialized form and showing little decided adaptation for a fossorial habit. The *Solenodon* humerus is much heavier proportionally, and consequently is much more angular in the attachment areas. The Haitian animal lacks the supratrochlear foramen, the head of the humerus is much more elliptical and the deltoid ridge is more greatly expanded. The differences for the most part appear to be responsive specializations to a fossorial habit. Relationship in primitive characters is more clearly shown by a comparison with *Centetes* and *Hemicentetes*, where modification by peculiar environment has not played a part. The *Erinaceus* humerus only approximately resembles that of *Nesophontes* and does not show as close a resemblance as the *Zalambdodonts* cited, but the *Gymnura* humerus bears a very striking likeness to the *Nesophontes* humerus. The arboreal type of humerus, as exemplified by *Tupaia*, shows such a parallelism with the humerus of *Nesophontes* that the evidence should not be passed over lightly. The *Talpids* are too highly specialized in the fore limb to give any clues through comparison, except it should be noted that a primitive humerus, such as that of *Nesophontes*, has the possibilities for the *Talpid* specialization. The more primitive condition of the *Soricid* humerus, using *Crocidura* as a type, bears significant likeness to the *Nesophontes* humerus.

The ulna (text Fig. 23) is of the primitive placental type—long, slender and nearly straight. It is flat and thin for most of its length, with a large, strong olecranon process which is well ridged for tendon

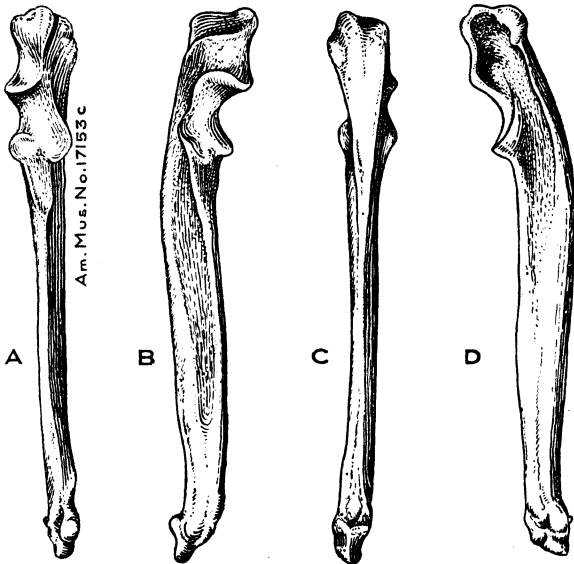


FIG. 23.—*Nesophontes edithae*. Right ulna: A, anterior aspect; B, external aspect; C, posterior aspect; D, internal aspect. $\times 5/2$

attachment. The sigmoid cavity is ample. There are well-defined surfaces for the articulation of the radius and for the pisiform and cuneiform.

Ulnae collected.—33, most of them perfect.

Measurements of Ulna of Nesophontes edithae

	Greatest length	Greatest antero-posterior width	Length of olecranon from border of sigmoid cavity
♂			
a.....	25.1	2.3	4.0
b.....	25.6	2.2	4.1
c.....	27.0	2.7	4.3
d.....	25.0	2.4	3.9
e.....		2.3	3.7
♀			
f.....	23.4	2.2	3.0
g.....	23.3	2.2	3.3
h.....	23.4	1.9	3.6
i.....	22.5	2.0	3.0
j.....	22.1	1.9	3.0

The *Nesophontes* ulna compares well with the shrew ulna, *Crocidura*, but there is rather more specialization to be seen in the olecranon region of the latter. The primitive zalambdodonts—*Centetes*, *Hemicentetes*, and less closely *Solenodon* and *Potamogale*—show remarkably close similarity to *Nesophontes* throughout. The *Erinaceus* ulna is also sufficiently generalized to be closely compared with *Nesophontes*. The ulna of *Gymnura* is very similar and the greatest difference seems to be merely in the curve of the bone. The ulna of *Tupaia* bears out the resemblance expressed by the humerus and agrees, in the main, quite well with *Nesophontes*.

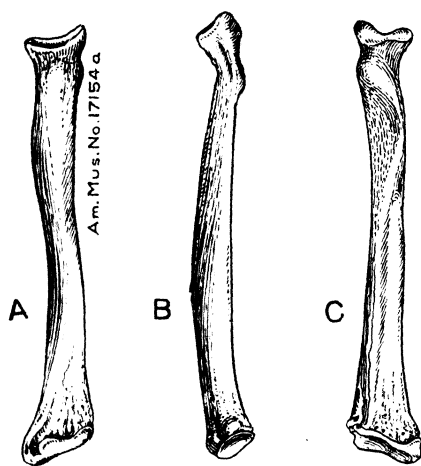


FIG. 24. *Nesophontes edithae*. Left radius: A, anterior aspect; B, external aspect; C, posterior aspect. $\times 5/2$

The radius (text Fig. 24) is moderately bowed, nearly uniform in cross-section throughout, and with a slight distal expansion. It has a conspicuous tubercle and well-marked insertion areas for the supinator and pronator muscles. There is a well-defined curve for the extensor tendon, and the articulating surfaces of the bone, both proximal and distal, are large. Considering the small size of the radius, the muscle insertion areas are unusually well marked.

Radii collected.—8, most of them perfect.

Measurements of Radius of *Nesophontes edithae*

	Greatest length	Transverse width at mid-point
♂		
a.....	20.9	1.5
b.....	18.7	1.2
c.....	18.8	1.2
d.....	20.6	1.5
e.....	19.0	1.1
♀		
f.....	17.1	0.9

Centetes and *Solenodon*, while rather closely agreeing with *Nesophontes* as to radii, are not proportionally as well equipped for pronation and supination. Although the bones of these two genera are much larger, and therefore should be more clearly marked off for muscle insertion, they are actually smoother than the small radius of *Nesophontes*. *Erinaceus* has a radius quite similar to that of *Nesophontes*, and the Shrew radius (*Crocidura* and *Blarina*) is also similar.

Although several ribs of *Nesophontes* were found, mostly from the anterior part of the series, it is not possible to draw very satisfactory deductions from the material. The ribs are not very strongly curved and the greatest degree of curving is at the proximal end. On some of the ribs the tubercle is fairly well developed, but on the longer ribs the tubercle facet is wanting or is undifferentiated from the surface of the rounded head. The shaft of the rib is strong, compressed, but expanded distally to form a thickened articulation surface for the costal cartilage. In most cases there is a well-marked groove along the shaft.

Ribs collected.—15, most of them perfect.

Measurements.—Sex indeterminable, ♀ (?). Greatest length, third (?) rib, 15.6 mm.; ninth (?) rib, 19.7; greatest breadth of shaft, third rib, 1.5.

Judging from the curvature of the few ribs collected, the body of *Nesophontes* must have been deep rather than broad. In the characters of the ribs themselves, considerable resemblance is shown to those of *Crocidura* and to *Gymnura*. *Centetes*, as well, should be included in this comparison, although in some details, such as the more rounded shaft and the better-developed tubercle, a decided difference is displayed. The *Solenodon* rib is compressed in a plane at right angles to the plane of compression in the *Nesophontes* rib, and this is confirmatory of the hypothesis that *Nesophontes* had a deep body and not a widened-out one like *Solenodon*. None of the other insectivores examined have such a

knob-like expansion for the costal attachments on the distal end of the ribs.

The sacrum (text Fig. 25) is composed of three vertebrae and is much wider at the cephalic than at the caudal extremity. The neural spines are not fused to form a continuous dorsal crest and they are not very high. The cephalic articular surfaces are of medium size, but the caudal articulations are rather small. The lateral borders curve gently from the alae to the third sacral vertebra. The dorsal foramina are very large and the ventral foramina are fair-sized. In one specimen, probably that of an old individual, advanced fusion with the first caudal vertebra is shown. The sacrum shows no characters of specialization.

Sacra collected.—7.

Measurements.—Length through centra, ♂ 12.8, ♀ 11.9 mm., breadth across alae, ♂ 9.6, ♀ 8.2.

The *Nesophontes* sacrum finds its closest resemblance in the sacrum of *Crocidura* and others of the Soricidae, the proportions of the different

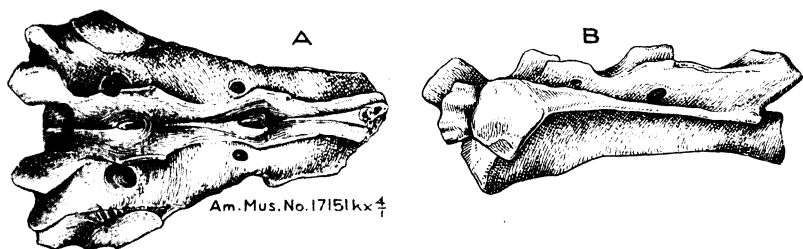


FIG. 25.—*Nesophontes edithae*. Sacrum: A, dorsal aspect; B, lateral aspect. $\times 4$

elements being, in general, similar. The sacrum of the primitive zalambdodonts, *Centetes* and *Hemicentetes*, is decidedly different in the proportions of the first two sacral vertebrae, *Hemicentetes* resembling *Nesophontes* in this respect rather more than does *Centetes*. The *Solenodon* sacrum, of four vertebrae and with the neural spines fused to form a crest, is quite dissimilar to the *Nesophontes* sacrum. The Erinaceidae have quite a high sacrum of nearly uniform width and need no detailed comparison here. The sacrum of the arboreal *Tupaia* is much wider and of a structure widely different from that of the Porto Rican insectivore.

The innominate bone (text Fig. 26) is simple and unspecialized. The main axis of the element is nearly straight. The ilium is long, slender and trihedral, expanding anteriorly in the transverse plane, with the external border a symmetrical curve. The ilium probably does not enter into the acetabulum, judging from a specimen which has been broken and shows a sutural contact. The articulating surface of the ilium ex-

tends from about the middle of the bone to the terminal fourth. The ischium is laterally compressed, expanding where it articulates with the pubis, and seemingly does not have an osseous connection with the

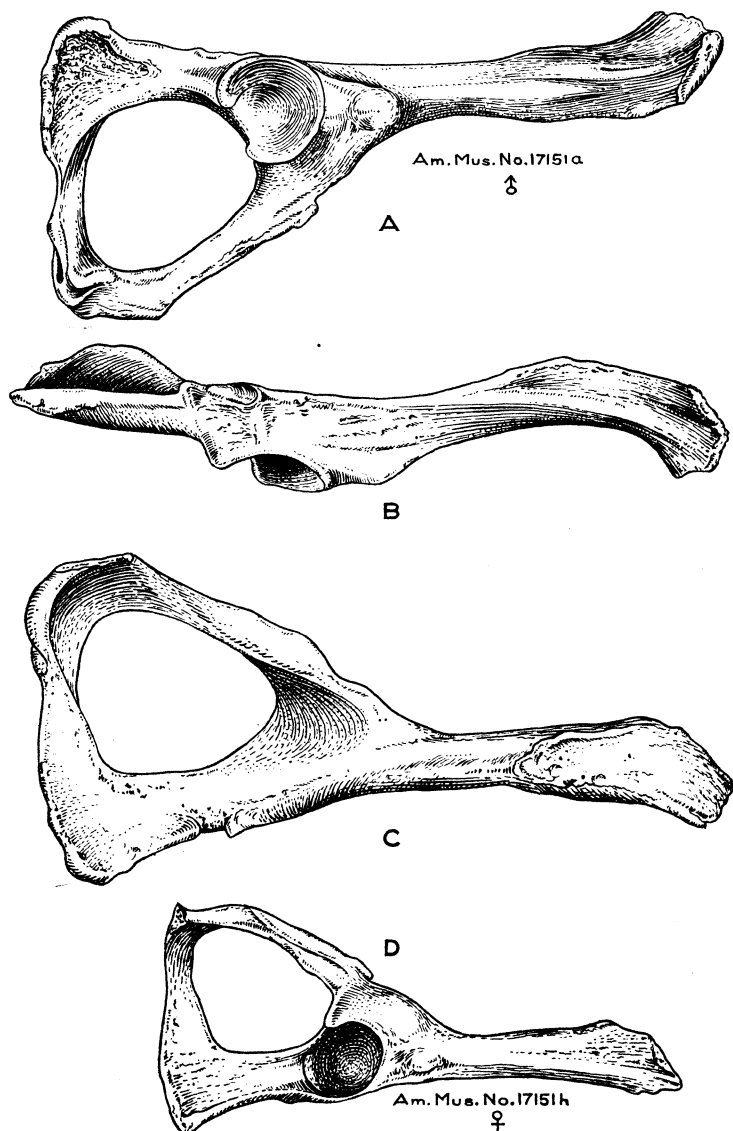


FIG. 26.—*Nesophontes edithae*. Right innominate of adult male: A, external aspect; B, dorsal aspect; C, internal aspect. Left innominate of adult female: D, external aspect. $\times 5/2$

sacrum. The ischial spine is present and there is a noticeable roughening for tendon attachment along the distal portion of the ischium. The pubis is flat, slender and straight for most of its length, with a slight inward curvature at the symphyseal region. Apparently there is either very slight fusion of the pubis at the median symphysis or none at all, since the edge of the bone has such a small, roughened area in the symphyseal region. The acetabulum is deep and cup-like, with a wide cotyloid notch. The obturator foramen is a large and roughly triangular opening. The contact of the innominate bone with the sacrum occurs only along the ilia.

Innominate collected.—59, a large part are perfect.

Measurements of Innominate Bone of Nesophontes edithae

	Greatest length of innominate bone	Anterior border of acetabulum to anterior end of ilium	Greatest width across ischium + pubes	Greatest diameter of acetabulum	Greatest diameter of obturator foramen
♂					
a.	33.9	19.0	16.0	5.1	9.8
b.	33.4	18.9	16.0	5.2	9.3
c.				5.2	
d.	35.1	20.9		5.4	
e.	32?	18.9		5.0	
♀					
f.	27.1	16.1	11.2	4.1	7.4
g.	27.2	16.3	12.0	4.0	7.7
h.	26.7	15.8	11.0	3.9	7.7
i.	25.7	15.0	10.8	3.8	6.9
j.	24.7	15.0		3.7	
Young ♂ ?					
k.	29.7	17.4	13.2	4.2	8.0
l.	29.5	16.8	12.8	4.1	8.0

The innominate bone of *Nesophontes* most nearly resembles that of the zalambdodonts, *Solenodon*, *Centetes*, *Hemicentetes* and *Microgale*. Agreement with *Potamogale* is less intimate because this structure is more highly specialized in the latter genus. The simple characters of the different elements of the pelvic girdle, which lack any of the specialized variations in form found in the higher groups of insectivores, are sufficient to distinguish the *Nesophontes* innominate from most of the Insectivora outside of the Zalambdodonta. In this respect *Erinaceus* has progressed but little, if any, past the primitive condition found in *Nesophontes*, while in the case of *Blarina* and *Crocidura* a possible evolution from this condition is seen.

The femur (text Fig. 27) is of a very generalized type with a straight, smooth shaft of nearly uniform cross-section from trochanters to condyles. The well-rounded head represents fully half of a sphere. The deep constriction at the neck is continuous except at a point on the upper posterior surface, where the rounded surface of the head terminates abruptly at the edge of the trochanteric fossa in a V-shaped ridge. Both greater and lesser trochanters are well developed and almost equal in size. The posterior intertrochanteric line and the trochanteric fossa are conspicuous and well defined. The third trochanter is present as a prominent, rounded process on the compressed, external border of the shaft. The condylar region is normal. The femur of males is so much larger

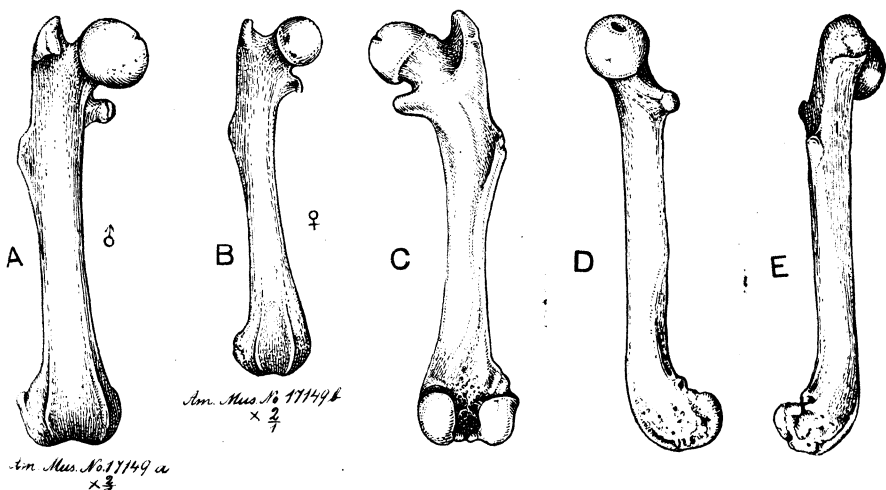


FIG. 27.—*Nesophontes edithae*. Right femur of adult male: A, anterior aspect; C, posterior aspect; D, internal aspect; E, external aspect. Right femur of adult female: B, anterior aspect. $\times 2/1$.

and heavier than that of females that some of the insertion areas, especially in the region above the intercondylar notch, are more clearly shown. However, there are some of the largest of the femora which are very smooth and with very little rugosity at any point.

Femora collected.—144, most of them perfect.

In many details the femur of a male *Nesophontes* resembles the *Solenodon* femur; the disparity in size is great and the femur of the latter is proportionally heavier than that of *Nesophontes*, but the development of the different areas and processes in the two genera is almost identical. Both have the rounded surface of the head extended toward the greater trochanter in a V-shaped ridge, but the head of *Nesophontes* is noticeably the better developed and more restricted at the neck. *Nesophontes*

differs from *Erinaceus* in having a femur with better-developed trochanters, the third trochanter of the former genus being very small, and a much deeper trochanteric fossa.

Compared with the femur of a large shrew, *Crocidura nyansae kiru*, from the Belgian Congo, close agreement in general structure is observed, but the shrew femur lacks the trochanteric fossa and the intertrochanteric line so well marked in *Nesophontes*.

The femur of *Scalopus* has the third trochanter greatly developed and high on the shaft, thereby differing from *Nesophontes*, but in the approximation of the convex surface of the head toward the greater trochanter there is similarity.

The femur of *Nesophontes*, because of its primitive character, needs no comparison with such genera as *Rhynchocyon*, *Macroscelides*, *Chrysochloris* and *Tupaia*. In its generalized characters it agrees fairly well with any of the primitive insectivore types, the best agreement being with the genera discussed above.

Measurements of Femur of Nesophontes edithae

	Length	Diameter of head	Greatest breadth across tips of trochanters	Least width of shaft	Greatest width across condyles	Width across articular surface
♂						
a.....	28.0	4.0	8.4	2.9	6.7	3.7
b.....	26.8	3.8	8.2	2.8	6.1	2.9
c.....	26.6	3.7	8.0	2.7	6.1	3.1
d.....	29.2	4.2	8.8	2.9	6.6	3.6
e.....	28.0	4.1	8.5	2.8	6.8	3.9
f.....	27.9	3.8	8.2	2.9	6.2	2.9
g.....	27.8	4.0	8.3	3.0	6.6	3.4
h.....	27.0	3.7	8.7	2.9	6.1	2.8
i.....	27.4	3.8	8.4	2.6	6.4	3.1
j.....	28.7	4.1	8.5	2.9	6.8	3.0
Average....	27.74	3.92	8.40	2.84	6.44	3.24
♀						
k.....	23.1	2.9	6.4	2.4	5.2	2.5
l.....	22.9	3.1	6.5	2.3	5.4	2.8
m.....	22.9	3.0	6.5	2.3	5.1	2.5
n.....	22.7	3.0	6.4	2.5	5.3	2.8
o.....	24.5	3.2	6.9	2.5	5.7	2.5
p.....	23.5	3.0	6.7	2.3	5.2	2.7
q.....	22.5	3.2	6.7	2.5	5.3	2.7
r.....	22.7	3.2	6.5	2.5	5.4	2.7
s.....	23.1	3.2	6.3	2.3	5.4	2.7
t.....	22.6	3.2	6.5	2.3	5.3	2.5
Average....	23.05	3.10	6.52	2.39	5.33	2.64

The tibia (text Fig. 28) is quite long, being slender and nearly straight throughout most of its length, with a smooth shaft and no special insertion areas other than that for the tibialis anticus muscle. The crest of the anterior border is sharp and extensive and there is a well-marked concavity along the outer aspect where the tibialis anticus attaches. The tibia has a very flat proximal end with a low median ridge. The tuber-

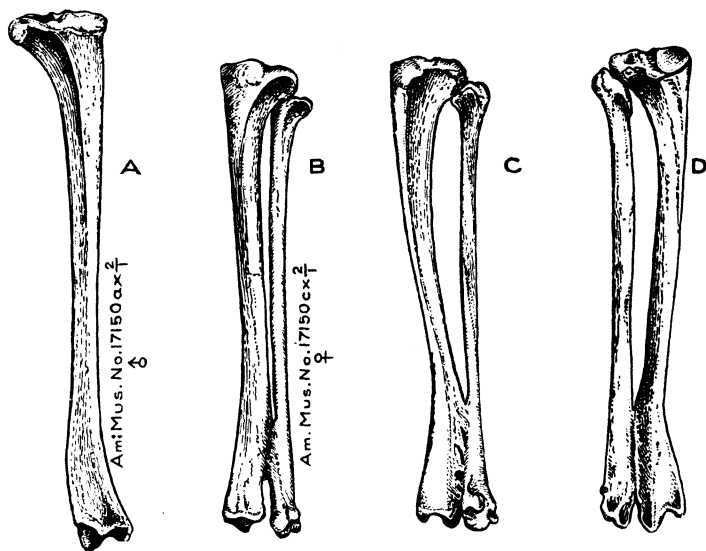


FIG. 28.—*Nesophontes edithae*. Right tibia of adult male: A, external aspect. Left tibia and fibula of adult female: B, antero-external aspect; C, external aspect; D, posterior aspect. $\times 2/1$.

osities are normal. The facet for the fibula is small, facing directly downward and not obliquely downward. The internal malleolus is long and the articulating surfaces indicate that the outside keel of the astragalus is much higher than that on the inside. The sexual dimorphism is very marked in the series of tibia.

Tibiae collected.—123, most of them perfect.

SCIENTIFIC SURVEY OF PORTO RICO

Measurements of Tibia of *Nesophontes edithae*

	Greatest length	Greatest width across tuberosities	Least width across anterior aspect		Greatest length	Greatest width across tuberosities	Least width across anterior aspect
♂				♀			
a....	36.0	7.3	1.7	k....	28.5	4.8	1.3
b....	33.0	6.1	1.5	l....	30.3	5.2	1.4
c....	34.6	6.2	1.4	m....	30.7	5.6	1.5
d....	34.4	6.5	1.7	n....	31.1	5.2	1.3
e....	34.5	6.0	1.6	o....	32.1	5.0	1.5
f....	33.3	5.9	1.4	p....	31.2	5.5	1.5
g....	36.2	6.3	1.6	q....	30.7	5.2	1.5
h....	35.2	6.4	1.5	r....	30.7	5.4	1.3
i....	34.6	6.3	1.7	s....	31.9	5.3	1.5
j....	33.1	6.0	1.6	t....	31.4	5.5	1.5
Ave.	34.49	6.30	1.57	Ave.	30.86	5.27	1.43

In the character of simple, smooth, and slightly curved shaft the tibia of *Nesophontes* displays its primitive nature. Among all the Insectivora, the retention of an equal degree of generalization is shown only by *Solenodon*, *Centetes*, *Hemicentetes* and *Tupaia*.

The fibula (text Fig. 28) is long, slender and of nearly uniform cross-section. The shaft is very straight, and fusion to the tibia is so imperfect that the two elements were seldom found attached, and close inspection is necessary to locate the area of fusion at the distal end. Expansion of the shaft at both proximal and distal ends is moderate. The grooves for tendon passage at the distal end are well developed.

Fibula collected.—5, only one perfect.

Measurements.—♂: total length, 29 mm.; cross-section at a mid-point, 1 by .9 mm.

The fibula of *Nesophontes*, being almost free from the tibia, needs little comparison with most of the insectivore genera. As in the case of the tibia, the closest agreement in this primitive condition is found in the members of the Centetoidea, *Solenodon*, *Centetes*, *Hemicentetes* and in *Tupaia*.

The vertebral column is represented by comparatively few vertebrae, and hence cannot be described in detail, although a few vertebrae from each series are present. In most of its characters the column appears to be primitive. The atlas is of good size proportionally, with ample articulating surfaces and a well-developed tubercle for the longus colli muscle. The axis has a robust spine, higher than broad, large cephalic articulating surfaces, peg-like transverse processes, and a strong median ridge on

the ventral surface of the centrum, which gives the posterior aspect of the centrum a subtriangular appearance. The available material indicates that the anterior cervicals are normal. There is no trace of the dorsal spine on the few cervicals found. The sixth cervical has the three branches of the transverse process well developed, the costal element large and with an almost straight, ventral border. One of the first of the thoracic series is very short, with slender dorsal spine and well-marked articulation for the rib tubercle, but most of the thoracic vertebræ are too fragmentary to describe. The lumbar vertebræ are large, with well-formed processes and articulations. The dorsal spine is restricted to the anterior half of the vertebra because of the narrow, V-shaped indentation which runs forward between the two caudal articulations. The dorsal spine is low and forwardly inclined. The caudal vertebra, which is identified as that of *Nesophontes*, is a simple, rod-like element, with the length equal to about twice the diameter.

Vertebrae collected.—Atlases, 2; axes, 4; cervicals, 2; thoracics, 2; lumbars, 5; caudals, 1.

Measurements of Vertebrae of Nesophontes edithae

	Atlas	Axis	Cervical (sixth)	Thoracic	Lumbar	Caudal
Length of centrum.....		♂ 7.3 ♀ 6.5	♂ 3.2	♀ 2.4	♂ 5.2	6.0
Greater transverse breadth.	♂ 11.5 ♀ 11.3	♂ 8.8 ♀ ...	♂ 10.5	♀ 8.6	♂ 7.0	2.8

The vertebral column of *Nesophontes*, as a whole, does not closely resemble that of any other of the Insectivora. In most details it comes closest to *Crocidura* and *Centetes*. The *Crocidura* column has the atlas very similar, except for a longer tubercle; the axis has a wider dorsal spine; the cervicals are very similar to those of *Nesophontes* and have but very low dorsal spines; the thoracics have a low spine, but otherwise vary somewhat from *Nesophontes*; the lumbars have the same indentation between the posterior articulating surfaces, but are rather more specialized on the ventral surface; the caudals are similar in nature. *Centetes* agrees with *Nesophontes* in the characters of the axis, the cervicals (except for the presence of a pronounced dorsal spine), and the thoracics, but only partially in the lumbar region and not at all in the caudal series. *Erinaceus*, *Gymnura* and *Solenodon* all have primitive vertebral characters resembling *Nesophontes*, the greatest resemblances

being found in the cervicals, where, however, the dorsal spine is found in every case. The specialized *Tupaia* has marked resemblances in the low-spined thoracics and the posteriorly forked lumbar.

Summary of the Principal Characters of *Nesophontes edithae*

1. The skull is primitive in character—elongate, tubular, slightly constricted interorbitally (hence with large olfactory chamber), lacking an ectopterygoid fossa, possessing large infraorbital foramen, large foramen magnum, incomplete zygomatic arch, prominent lambdoid crest and low sagittal crest.

2. The mandible has a curving ventral outline, a high coronoid, well-developed angular process and mandibular condyle with transverse expansion and backwardly directed articulation.

3. The dentition lacks only a premolar above and below of being the full, primitive, placental set of 44. The milk dentition is well developed, the milk incisors persisting into early maturity. The incisors are not highly specialized, the upper canine is two-rooted and large, the premolars are of the sectorial type, and the molars have the high V-shaped cusps above (protocone, metacone and paracone), the tuberculo-sectorial trigonid and talonid below.

4. The humerus is unspecialized, retaining its normal form and with large entepicondylar and supratrochlear foramina.

5. The ulna and radius are slender and unspecialized.

6. The innominate is normal in its development. The ilium is long, slender and trihedral, the ischia have well-developed spines and are well separated, and the pubic elements do not coalesce at the symphysis.

7. The femur has the third trochanter and a well-developed intertrochanteric line.

8. The tibia and fibula are separate, slight ossification taking place distally.

9. The vertebrae lack any specialization.

Nesophontes is widely separated from any of the existing families of insectivores, but because of its exceedingly primitive structure agreement in a few characters is found with each family. No living insectivore has such an assemblage of generalized characters and the gap between any of them and *Nesophontes* is apparently very great.

A number of characters link the Nesophontidae with the Centetoidea. The general form of the skull, with elongate rostrum, nearly full primitive dentition, tritubercular molars, absence of jugal, large infraorbital foramen, fused nasals, completely ossified palate and non-inflated brain-

case, indicate a degree of relationship with such forms as *Centetes* and *Solenodon*. *Nesophontes*, however, is even more primitive than these genera, not only in details of the skull but in the skeleton. The protocone in the *Nesophontes* molar is a very important cusp of large size and has not begun to suffer from the reduction and subordination shown in living centetids; the incisors and canines bear the primitive relationship to each other and the skeleton in general is more primitive.

Nesophontes was undoubtedly of more primitive habit than those zalambdodonts to which it bears the closest resemblances—*Solenodon* and *Centetes*. The skeleton shows none of the fossorial adaptations of *Solenodon*, and the only developments aside from the purely terrestrial are arboreal. The forearm shows marked powers of pronation and supination, and, when taken in connection with the unthickened shafts of the bones, this faculty could have found expression, seemingly, only when the animal climbed. Perhaps it was both terrestrial and arboreal, or semi-arboreal, for only on this hypothesis can the fundamentally generalized skeleton be accounted for. The surprising parallelism with *Tupaia* in the characters of the humerus, ulna, tibia and vertebrae is significant in this connection as to an arboreal habit.

Nesophontes agrees with the tupaoid,⁷ erinaceoid and soricoid forms only in the very primitive characters. *Gymnura* has such a generalized skeleton that many resemblances are noted when the skeleton of *Nesophontes* is compared with it; this is true of *Erinaceus* to a lesser degree.

In its primitive type of skeleton with arboreal specialization, *Tupaia* shows unexpected similarities to *Nesophontes*. In skull characters the differences are profound.

Of the soricoid forms, the Talpidae are so highly specialized in many particulars that resemblance to *Nesophontes* is very remote. Of the different genera, the Old World *Talpa* presents the closest agreement in characters of dentition, the only part of the skeleton that may be consistently compared. The agreement consists in the relation of canine to incisors and the well-developed metacone. Differences equally important are the reduced protocone and well-developed paracone of *Talpa*, as contrasted with the reverse condition in *Nesophontes*.

The Soricidae, as far as their characters have been unchanged by specialization, have many skeletal characters in common with *Nesophontes*. Using large species of *Crociodura* as bases of comparison, agreement was

⁷ For the sake of completeness, the Menotyphla were compared with *Nesophontes*, although there can be no doubt that *Nesophontes* is a true insectivore in the restricted sense.

found in the following characters:⁸ the shape of the scapula, the development of the spine-acromion complex and the deep infraspinous fossa; the ulna and radius; the humerus; the sacrum; the vertebræ; the ribs. The dentition, especially the incisor-canine series, is very highly developed in the shrews, but in the procumbent upper incisors and the bilobed lower incisors of *Nesophontes* a possible step in the direction of soricid specialization is seen, and there are marked resemblances in the molar crowns. *Crocidura* has a high metacone and reduced paracone very similar to *Nesophontes*. The shrew protocone, however, is greatly reduced and the molar has added a postero-internal spur not found in *Nesophontes*. The best agreement between *Crocidura* and *Nesophontes* is in the following skull characters: the wide separation of postglenoid process and periotic, the lack of outgrowths from the alisphenoid and basisphenoid to form part of the bulla, the ring-shaped tympanic, the position of the foramen ovale between the postglenoid process and the pterygoid wing of the alisphenoid, the glenoid cavity opening forward instead of downward, the elongate basicranial region, the greatly reduced anterior and posterior zygomatic roots, the optic foramen opening into the sphen-orbital fissure in *Nesophontes* (confluent with it in *Crocidura*) and the posterior mental foramen situated below pm₄.

From the Leptictidae, *Nesophontes* differs radically, some of the main differences being the possession in this family of four premolars, as against three in *Nesophontes*; the presence of a well-developed zygomatic arch, the unfused nasals and the much broader, heavier skull, with prominent lateral longitudinal crests.

It will be seen from the foregoing paragraphs that the Nesophontidae is a very well circumscribed family and is not immediately related to the other insectivore families. Because of the undeveloped possibilities in its structure, the Porto Rican animal might be near the line of descent of several of the modern families. On the one hand, *Solenodon* or *Centetes* might have evolved from such a primitive ancestor as *Nesophontes*, while on the other hand the possibility that the Soricidae might have descended from an early nesophontid must not be overlooked. *Nesophontes* is such a type as might well be looked for in the Eocene and its persistence down into the late Pleistocene or early Recent may be explained by its insular isolation. If this interpretation of its relationships be placed upon *Nesophontes*, it implies a related ancestry for the Centetoidea and the Soricidea—a condition already suggested by Leche (1907, p. 121).

⁸ These points are brought out in the description of the different skeletal elements of *Nesophontes*.

Skeletons of the following species have been available for comparison with *Nesophontes*:

<i>Tupaia speciosa</i>	<i>Talpa europaea</i>
<i>Macroscelides rozeti</i>	<i>Scalopus aquaticus</i>
<i>Rhynchocyon claudi</i>	<i>Potamogale velox</i>
<i>Gymnura rafflesii</i>	<i>Solenodon paradoxus</i>
<i>Erinaceus europaeus</i>	<i>Centetes ecaudatus</i>
<i>Sorex personatus</i>	<i>Hemicentetes semispinosus</i>
<i>Blarina brevicauda</i>	<i>Ericulus telfairi pallescens</i>
<i>Crocidura nyansae kivu</i>	<i>Oryzoryctes tetradactylus</i>
<i>Crocidura rubicunda?</i>	<i>Microgale dobsoni</i>
<i>Myogale moschata</i>	<i>Chrysochloris trevelyani</i>

Status of the Family NESOPHONTIDAE

The difficulty in determining the relationships of the Nesophontidae lies not so much in establishing the validity of the group as a family, but rather in finding other families of insectivores enough like it to claim affinity. The characters which set the Nesophontidae apart are obvious, but the resemblances with other insectivores are not so patent, except for the many primitive characters whereby similarity may be found, to some degree, with practically any of the insectivore groups.

The position in which I placed the Nesophontidae in my description of the family (1916), rather nearer to the soricoids than to the zalambdodonts, was not accepted by Dr. G. M. Allen (1918, p. 135), who believes that the true condition is the reverse.

Dr. Allen advances comparisons which give strong support to his contention, and I freely grant that there is a deep gulf between the primitive *Nesophontes* and the highly specialized Soricidae or Talpidae; so, also, is there a great gap between *Nesophontes* and *Solenodon*, to bridge which Dr. Allen presupposes special development of the generalized *Nesophontes* condition to evolve the present-day *Solenodon* condition. The profound changes which would develop a *Solenodon* from a nesophontid would also carry a nesophontid well into the soricid stage, if along slightly different lines. The main difference in the two comparisons is that the Soricidae are very highly developed as we find them today (with respect to some features of skull and dentition), whereas the zalambdodonts represent a more primitive stage. However, the zalambdodont dentition appears as early as the Basal Eocene in *Palaeoryctes* of Matthew (1913, p. 309). Gregory (1910, p. 268), writing of the evolution of the Centetoidea, says:

Since the common origin of the Centetoidea and Erinaceoidea seems well assured, from the evidence cited on page 266, we must believe that most of the

special Centetid characters above enumerated, except possibly the V-shaped protocone of the upper molars, the lack of a hypoconid, and the position of the posterior mental foramen, have been acquired by the Centetidae after they became separated from the forerunners of the Erinaceoidea.

The date of this separation can at present only be determined within very wide limits. It was certainly not later than the Lower Eocene, for in the Eocene and Oligocene the family Leptictidae had already become Erinaceoid in many characters, while by the time of the Lower Oligocene the Zalambdodonts had differentiated into Chryschlorids (p. 258) and Centetids (*Apternodus*, p. 259), the Solenodontidae also possibly being represented by *Micropternodus* (p. 259).

As to the lower limit for the date of separation, there is still less to guide us. If the *Potamogale* upper molar be more primitive than the *Microgale* molar, then the morphological gap between the *Microgale* and presumably the *Apternodus* molar on the one hand and the *Ictops* molar on the other is very profound, and the separate phylogenetic lines representing the Leptictidae and the Centetidae would have to be prolonged back very far before they would run together. If, on the contrary (as seems on the whole more probable), the *Microgale* molar is the primitive Centetid type, then the principal difference between it and the more primitive *Ictops* molar lies in the reduction of the paracone and sometimes its fusion with the parastyle. In that case the lower limit for the separation of the Erinaceoids and Centetoids might perhaps be the Basal Eocene or Upper Cretaceous.

Consequently, if the zalambdodont molar was derived from a nesophontid molar the development must have taken place at a very remote time. Dr. Matthew writes of the zalambdodont molar in his report on *Palaeoryctes*: "that it has probably, although not certainly, passed through a normal tritubercular stage in its evolution" (l. c., p. 313). The same author, writing in 1909 on the Insectivora of the Bridger Basin, page 543, says:

Whatever theoretic views may be held as to the ultimate derivation of the dilambdodont from the zalambdodont type of molar, or *vice versa*, the fact remains that in Mesozoic as in modern times the two were entirely distinct, and that there is no direct evidence for the derivation of any dilambdodont families of insectivora from zalambdodont ancestors. The Oligocene zalambdodonts may or may not be related to the Chryschloridae, Centetidae or Solenodontidae, but they are not related to the Talpidae, Soricidae, Leptictidae, etc., and should not be placed even provisionally in any of these families.

While this may be taken to show the antiquity of the distinction between the zalambdodont and the dilambdodont dentition, it has bearing on the affinities of *Nesophontes* only in so far as to point out the improbability of a transition from the nesophontid molar to the *Solenodon* molar in the period since the Eocene. I have conceded earlier in my discussion of *Nesophontes* the possibility of evolving a *Salenodon* from

a *Nesophontes*, as far as structural data is concerned. Palaeontological data indicates that such structural changes, if they took place at all, transpired before the Eocene. Since *Nesophontes* is so well differentiated from the zalambdodonts on the one hand and the dilambdodonts on the other, it becomes more or less a question as to whether the hypothetical molar change of the unknown pre-Eocene should outweigh an apparent (although possibly unreal) affinity to the Soricoida molar.

While I have tried to show that the zalambdodonts, as far back as they have been discovered, are still far removed from nesophontids, it might be said with almost equal force that the same is true of the earliest known soricids and talpids. They, too, are well specialized families at their earliest appearance, although in their case the record does not go back to the Basal Eocene. In making the assumption that the line of descent of the Nesophontidae inclines toward the side of the Soricidae, I have pictured the primitive soricid as combining, to a greater or less degree, the primitive skeleton of the present-day shrew with the more generalized dentition (as compared with the Soricidae) of the moles. I would qualify my earlier use of the term Soricidae (Anthony, 1916, p. 728) and employ now Soricoida, in order to better include an ancestral form with generalized dentition and skeleton.

The Eocene talpoid forms are probably related to either moles or shrews, but probably they combined the more primitive dentition of the moles with the more primitive skeleton of the shrews, and may have lacked certain progressive features common to both families. (Matthew, 1909, p. 508.)

The Talpidae seem to be linked ancestrally with the Soricidae through the primitive genera, *Myogale*, *Urotrichus* and *Uropsilus*, the first of which approaches the typical Talpidae, while the last is shrew-like in almost everything except its dentition. (Gregory, 1910, p. 265.)

The Talpidae and Soricidae have very probably diverged from a common stem, the typical Talpidae having acquired high fossorial specializations in the limbs, while the Soricidae have developed a very peculiar and highly modified antemolar dentition. (Gregory, 1910, p. 263.)

But the numerous resemblances cited above, as well as certain generalized centetoid features of *Necrolestes*, seem only to warrant the inference that the stem form of the Soricoida (which was doubtless not yet mole-like in its limbs) is related to the stem of the Centetoidea on the one hand and to the stem of the Erinaceoidea on the other. (Gregory, 1910, p. 266.)

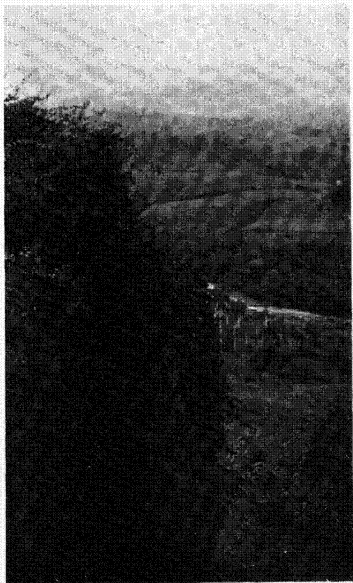
To sum up, the choice of affinity lies between the Zalambdodonta and the Dilambdodonta, and accordingly as the various characters of *Nesophontes* are given weight the hypothetical line of descent of the Nesophontidae may be diverted toward the one or the other. If the differences between *Nesophontes* and *Solenodon*—for example, such as the dif-

ference between the three-cusped W molar pattern of the former and the reduced two-cusped V pattern of the latter—do not outweigh the resemblances, such as “the shape of the skull, the incomplete zygomatic arch, the long, tubular rostrum, early fusion of the nasals (also in Soricidae), the slight inflation of the frontal region, large foramen magnum, prominent lambdoid and low sagittal crests, the tooth-formula, the double-rooted upper canine, and the transversely expanded mandibular condyle” (G. M. Allen, 1918, p. 135), which are, for the most part characters held in common by all primitive insectivores, then the Nesophontidae must have closer affinities with the Zalambdodonta than with the Soricoidae or any other superfamily of the Insectivora characterized as dilambdodont.

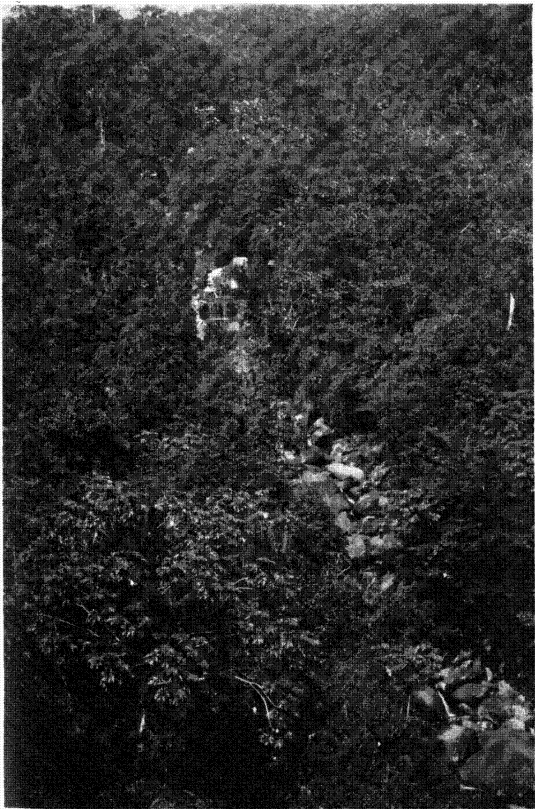
However, if the specialized features of the Soricoidae may be considered as a later development obscuring the true primitive condition, then serious consideration must be given to such agreement in characters between *Nesophontes* and *Talpa* as an identical fundamental arrangement of primitive cusps (modified to different degrees, but present in both cases), similarity in position of posterior mental foramen (under the last premolar in *Nesophontes*, approaching that condition in *Talpa*), and upper canines in the same stage of development, double-rooted and with normal relation to the tooth-row in both genera. Other genera of the Soricoidae—*Crociodura*, for example—are like *Nesophontes* in the following respects: high metacone and reduced paracone, wide separation of postglenoid process and periotic, no part of the alisphenoid or basisphenoid forming part of the bulla, ring-shaped tympanic, foramen ovale between postglenoid process and pterygoid wing of alisphenoid, glenoid cavity opening forward instead of downward, elongate basicranial region, reduced anterior and posterior zygomatic roots and optic foramen opening into the margin of the sphenoidal fissure. From the foregoing, it may be argued that the Nesophontidae have reasonable claims for inclusion in the Dilambdodonta rather than the Zalambdodonta. It may be overemphasizing these resemblances to include the Nesophontidae in the same superfamily with the Soricidae and the Talpidae. For that reason, and because of our present inadequate knowledge of Tertiary Insectivora, I feel that a definite statement as to the immediate status of the Nesophontidae partakes, more or less, of the nature of a guess. I believe, however, that we may expect to find the ancestors of the Nesophontidae in the dilambdodont rather than in the zalambdodont section of the Insectivora.



LIMESTONE HILLS ALONG ROAD FROM UTUADO TO ARECIBO



LOOKING OUT FROM COROZAL CAVE

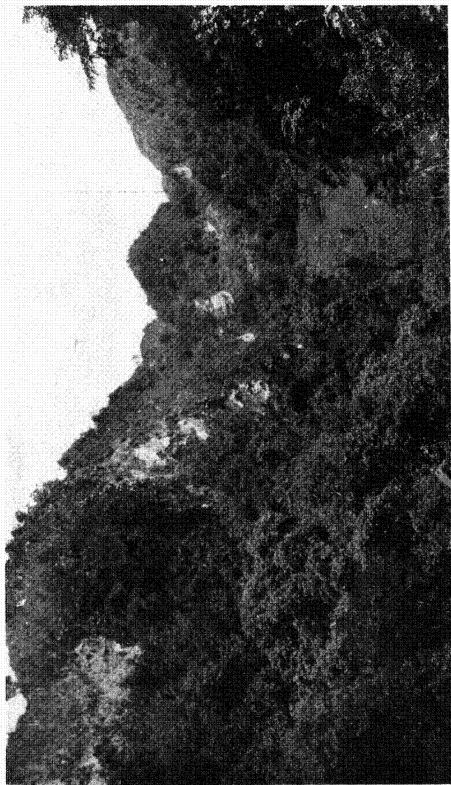


SLOPES OF LUQUILLO MOUNTAINS





VEGETATION IN LUQUILLO MOUNTAINS



REGION ABOUT MOROVIS



NEAR CUALES



ALONG ROAD FROM MANATI TO MOROVIS



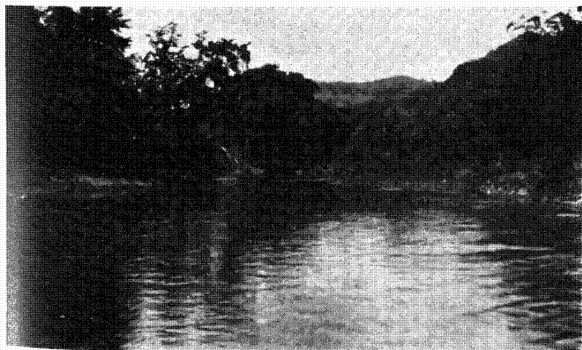
PALMS NEAR MOROVIS



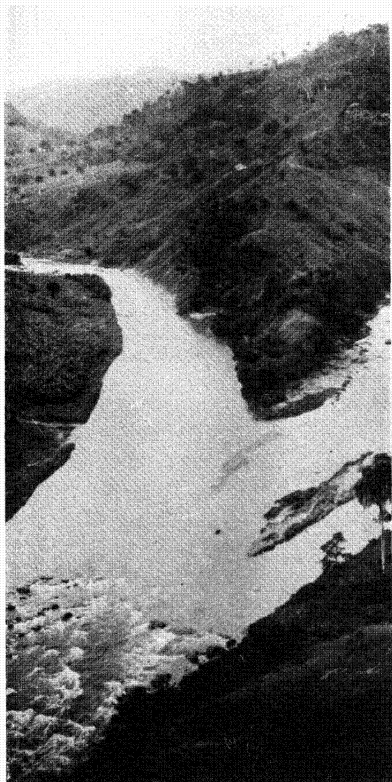
NEAR GUAYAMA



ALONG ROAD FROM NAGUABO TO GUAYAMA

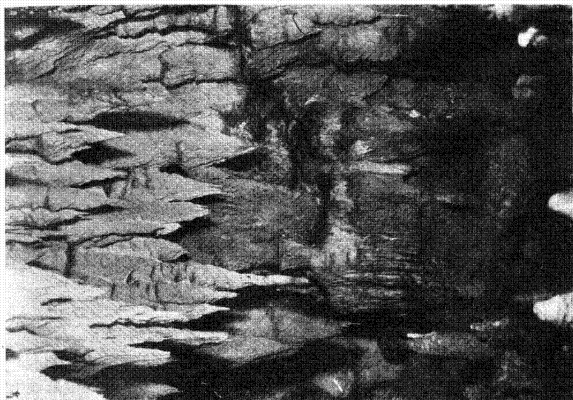


RIVER NEAR COAMO

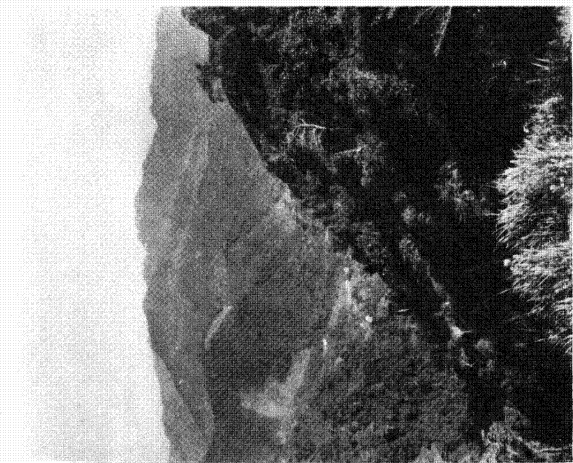


RIO GRANDE DE ARECIBO

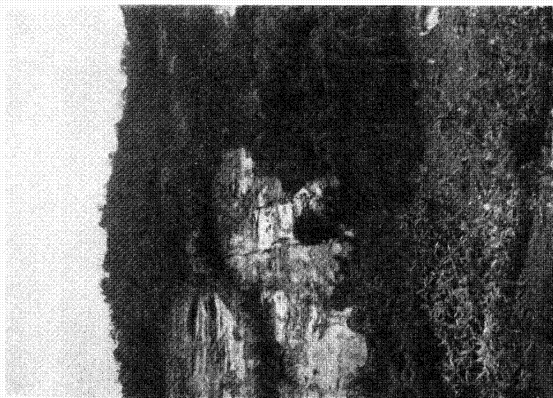




CAVE INTERIOR OF UNPRODUCTIVE TYPE



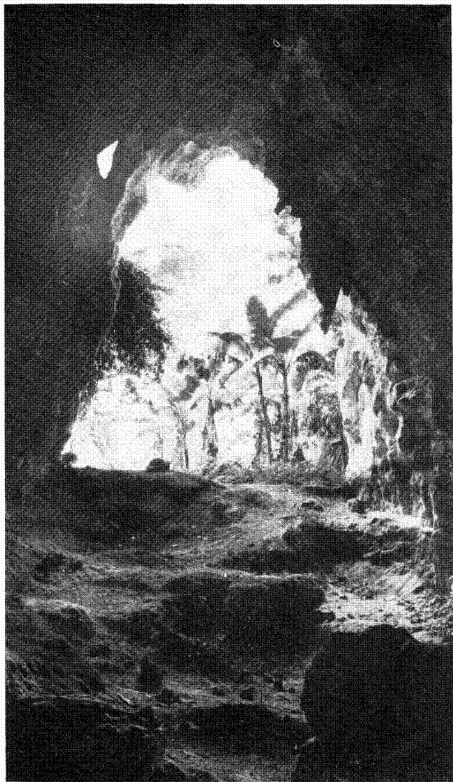
HIGH MOUNTAINOUS REGION NEAR CAVE



ENTRANCE TO COROZAL CAVE



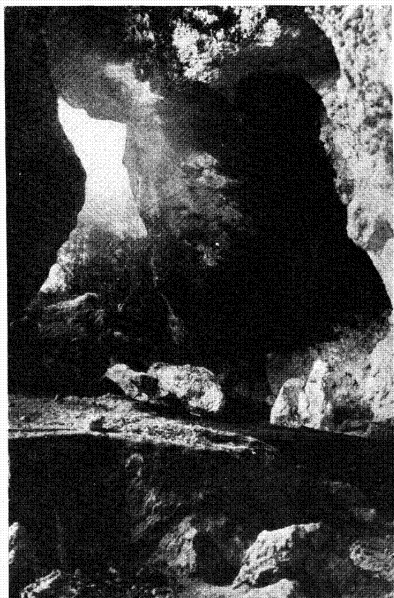
PIEDRA DE LA CUEVA, OLD LOUISA



A LARGE CAVE NEAR MOROVIS, THE CAVE OF SAN MIGUEL

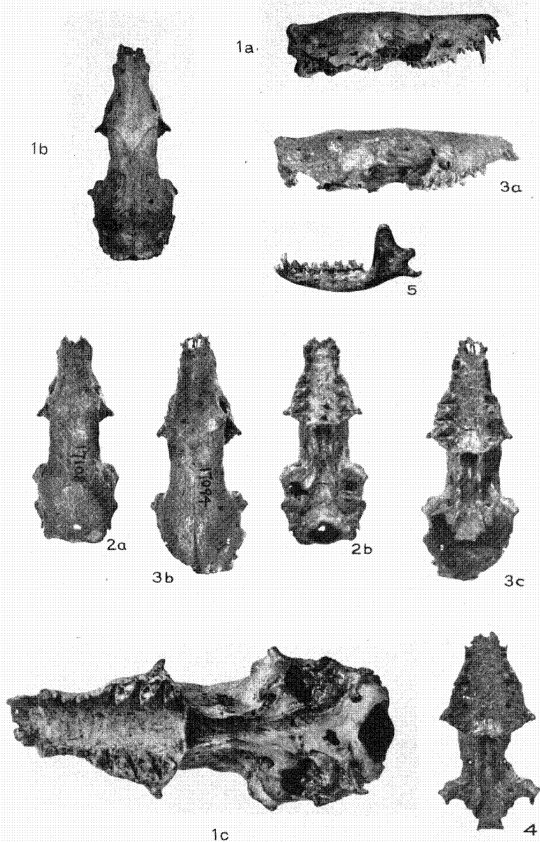


INTERIOR OF COROZAL CAVE



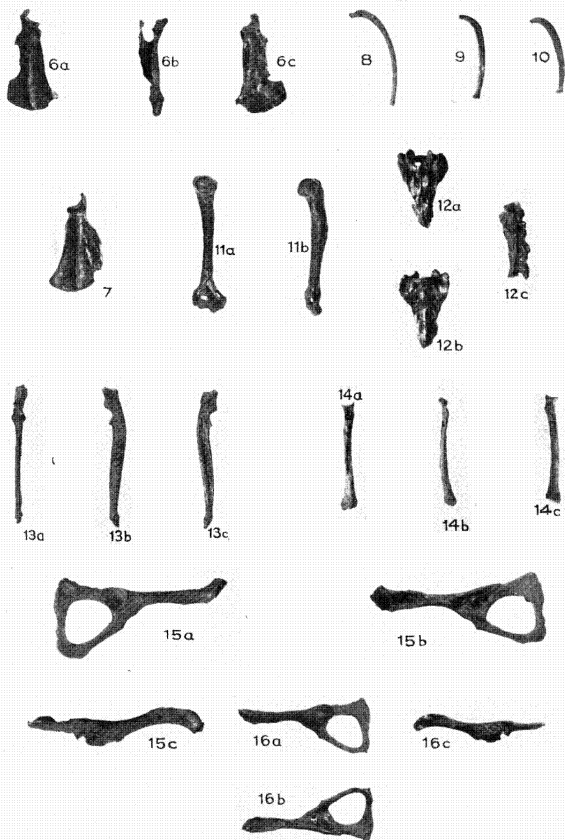
SMALL CAVE NEAR THE CAVE OF SAN MIGUEL

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NESOPHONTES EDITHAE FROM MOROVIS, PORTO RICO

Figs. 1a, 1b, No. 14174, type, ♀. $\times 1/1$.Fig. 1c, No. 14174, ♀. $\times 2/1$.Figs. 2a, 2b, No. 17108, ♀. $\times 1/1$.Figs. 3a, 3b, 3c, No. 17094, ♂. $\times 1/1$.Fig. 4, No. 17112, ♂. $\times 1/1$.Fig. 5, ♀. $\times 1/1$.



NESOPHONTES EDITHAE FROM MOROVIS, PORTO RICO.

Figures natural size

Figs. 6a, 6b, 6c, right scapula; fig. 7, left scapula.

Figs. 8, 9, 10, ribs.

Figs. 11a, 11b, left humerus, ♂.

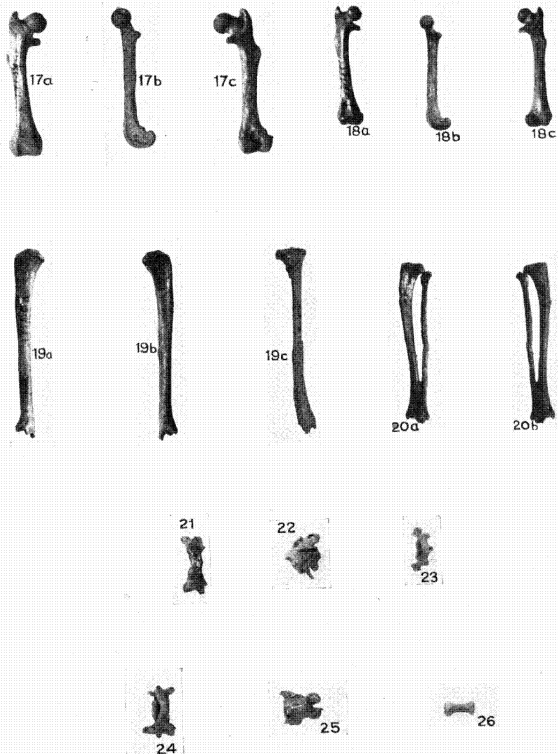
Figs. 12a, 12b, 12c, sacrum.

Figs. 13a, 13b, 13c, right ulna, ♂.

Figs. 14a, 14b, 14c, right radius, ♂.

Figs. 15a, 15b, 15c, right innominate, ♂.

Figs. 16a, 16b, 16c, left innominate, ♀.



NESOPHONTES EDITHAE FROM MOROVIS, PORTO RICO.
Figures natural size

Figs. 17a, 17b, 17c, right femur, ♂.
Figs. 18a, 18b, 18c, right femur, ♀.
Figs. 19a, 19b, 19c, right tibia, ♂.
Figs. 20a, 20b, left tibia, ♀.
Fig. 21, atlas.

Fig. 22, axis.
Fig. 23, thoracic vertebra.
Fig. 24, fifth cervical vertebra.
Fig. 25, lumbar vertebra.
Fig. 26, caudal vertebra.



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