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Postglacial remains of a vampire bat (*Chiroptera: Desmodus*) from Cuba

[Pp. 253—266, pl. XI, 5 text-figs.]

Postglacialne szczątki wampira (*Chiroptera: Desmodus*) z Kuby

Restos postglaciales del vampiro (*Chiroptera: Desmodus*) de Cuba

Abstract. Postglacial remains of a vampire bat belonging to a new subspecies *Desmodus rotundus puntajudensis* n. ssp. from a cave situated in Loma del Medio, Punta Judas, provincia Las Villas, Cuba, are described. Its relation to hitherto known forms of vampire bats is discussed. The list of other mammalian remains from the same fossil locality is given.

INTRODUCTION

In the collections of the Geological Institute of the Cuban Academy of Sciences a block of bone-breccia of dimensions about $20 \times 30 \times 40$ cm. was found. It was composed mostly of the skulls, skull fragments and mandibles of mammals and belonged to the material unearthed from the cave Centenario de Lenin, situated in Loma del Medio, Punta Judas, on the north-east coast of Las Villas province, Cuba.

A considerable part of the above-mentioned breccia was previously studied by Mayo (1970). In the remaining part, after its preparation in the spring 1973, following species of mammals could be determined (see table I.) The skull of a vampire bat discovered in this materials is the subject of the present publication.

The authors express their deep gratitude to Prof. Dr. K. Kowalski who made the collection of recent *Desmodus* skulls accessible to them and to Mr. Gilberto Silva Taboada who helped to collect necessary literature and made helpful comments during the preparation of this paper.

Table I

Mammalian remains in the studied fragment of bone breccia

	Number of specimens	%
Insectivora:		
Nesophontes micrus ALLEN 1917	110	63·6
Rodentia:		
Geocapromys columbianus CHAPMAN 1892	30	17·3
Boromys torrei ALLEN 1917	20	11·6
Chiroptera:		
Macrotus waterhousii GRAY 1843	12	7·0
Desmondus rotundus puntajudensis n. ssp.	1	0·5
Total	173	100·0

SYSTEMATIC PART

Family *Desmodontidae* GILL 1884

Genus *Desmodus* MAXIMILIAN 1824

Desmodus rotundus puntajudensis n. ssp.

Diagnosis. In general character the skull is similar to that in typical specimens of *Desmodus rotundus* but smaller and more delicate (Pl. XI). Jugal arch highest in its anterior part differs in this character from both living subspecies, in which the highest part is in the middle of the arch. Foramen occipitale magnum lengthened in its sagittal diameter (Table XI, Pl. XI, Fig. 4). Posterior part of the skull relatively stretched (Table III).

Derivatio nominis. From the name of the hills Punta Judas on north-eastern coast of Las Villas province, Cuba, where the fossil locality with remains of a new form is situated.

Locus typicus. Postglacial sediments of Cueva del Centenario de Lenin, Punta Judas, provincia Las Villas, Cuba. Coordinates: 071 and 848 on the sheet No. 4483 III of the map of Cuba in the scale 1:50 000, ICGC.

Stratum typicum. Upper layer of sediments, cemented with aragonite, collected in room I in Cueva del Centenario de Lenin, dated from Middle Holocene (MAYO 1970).

Holotype. Nearly complete skull (calvarium) with preserved neurocranium, left jugal arch and roots of incisors and canines. Holotype is preserved in the collections of the Geological Institute, Cuban Academy of Sciences, La Habana, inv. no. 7999/401 IG ACC. No other material is known.

As comparative material 15 skulls of *Desmodus rotundus* were used, 14 of which belong to the collections of the Institute of Systematic and Experimental

Table II

Comparison of dimensions of recent and extinct vampires

No.	Measurements in mm	Specimen from Punta Judas 7999/401	*Desmodus rotundus murinus* M/4721—30	*Desmodus rotundus* subfossil MF/991	*Desmodus rotundus rotundus* (after Husson 1962)	*Desmodus rotundus* (after Koopman 1958)	*Desmodus stocki* (after Jones 1958)	*Desmo. magnus* (after Olsen 1960)
1.	Total length of skull	22·34	23·12—24·50 23·85	23·48	22·8—24·4 23·7	—	26·5—28·2 27·4	—
2.	Condylobasal length	20·31	20·83—21·85 21·33	19·95	20·6—22·0 21·4	—	24·3—24·7 24·5	—
3.	Condyle to front of canine	18·35	18·08—20·00 19·55	18.10	19·0—19·6 19·4	—	—	—
4.	Length of base of cranium	17·81	17·16—19·30 18·45	17·07	17·5—19·1 18·5	—	—	—
5.	Width on jugal arches	12·44	11·64—12·60 11·99	11·68	11·8—12·6 12·1	—	14·0—14·1 14·1	—
6.	Interobrital breadth	5·97	5·17—5·72 5·42	5·60	5·0—5·5 5·3	5·1	5·9—6·2 6·1	5·3
7.	Distance from posterior border of palatinum to condyli	12·25	12·05—12·96 12·52	12·28	—	—	—	—
8.	Length of tooth-row C—Pm^2	3·11	3·54—3·60 —	—	3·3—3·5 3·4	—	—	—
9.	Breadth of foramen occipitale magnum	5·13	4·85—5·20 5·08	4·86	—	—	5·3—5·8 5·6	5·3
10.	Height of foramen occipitale magnum	5·05	4·25—4·80 4·51	4·60	—	—	—	—
11.	Breadth of palatinum measured to external borders of fossa canini	6·65	6·19—6·23 —	—	5·4—6·2 5·9	—	—	—
12.	Breadth of brain case	12·08	—	—	12·0—12·5 12·3	—	13·5—14·2 13·7	12

Zoology, Polish Academy of Sciences in Kraków (Inv. nos. MF/991 and M/4721—4733) and one, made accessible to us through the courtesy of Mr. G. Silva Taboada is labelled: Univ. of Kansas 39595, Mus. of Nat. Hist. 13050. All these specimens come from Mexico.

Description. Skull in general appearance delicate, brain case relatively lengthened (Table III), small sagittal crest present. On the brain case an oblique

Table III

Ratio of the distance from the posterior border of palatinum to the condylus to the distance from the condylus to the front of canine in the vampires

Material studied	%
1. Series of skulls of *Desmodus rotundus murinus* from the collection of the Institute of Systematic and Experimental Zoology	62.6—66.7 $\bar{x}$ = 64·0
2. Subfossil specimen from the same collection (MF/991)	67·8
3. Specimen from Punta Judas	66·8

groove going through parietale can be seen. Interorbital width smaller, but supraorbital bridge proportionally more massive than in recent forms. Jugal arches reach their greatest height in their anterior part and gradually get narrower (in the recent form they obtain their greatest height in the middle of their length) (Text-fig. 1). Foramen occipitale magnum is lengthened in

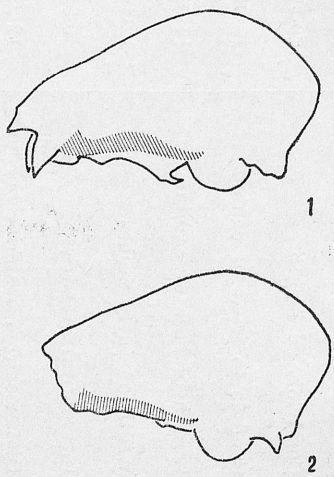

Fig. 1. The shape of jugal arch in *Desmodus rotundus murinus* (1) and *D. r. puntajudensis* n. ssp. (2)

sagittal diameter, much higher than in recent forms. Proc. condyli situated nearer one another than in compared recent specimens. Foramen intermaxillare is more lengthened in its anterior part, like in *D. rotundus rotundus*, septum in this foramen however more massive. The form of the postero-external margins of the palatinum, which are mildly rounded, is intermediate between two extant subspecies. Length of the tooth-row C-Pm² is smaller than in forms used for comparison (Table II), whereas the breadth of palatinum between the external borders of canine alveoli is larger than in recent *Desmodus rotundus*.

Dimensions (in mm.). Total length of the skull 22·34, condylo-basal lenght 20·31, length from the anterior border of canine alveole to the condylus 18·35, basal length of the skull 17·81, greatest width of jugal arches 12·44, breadth of brain case 12·08, height of brain case from basion 11·88, interorbital breadth 5·17, width of palatinum measured between the exterior borders of canine alveoli 6·65, length of the tooth-row C-Pm² 3·11, length from the anterior border of the incisor alveole to the posterior border of canine alveole 5·15, breadth of foramen occipitale magnum 5·13, height of foramen occipitale magnum 5·05, length of the alveole of incisor 3·12, smallest width between the

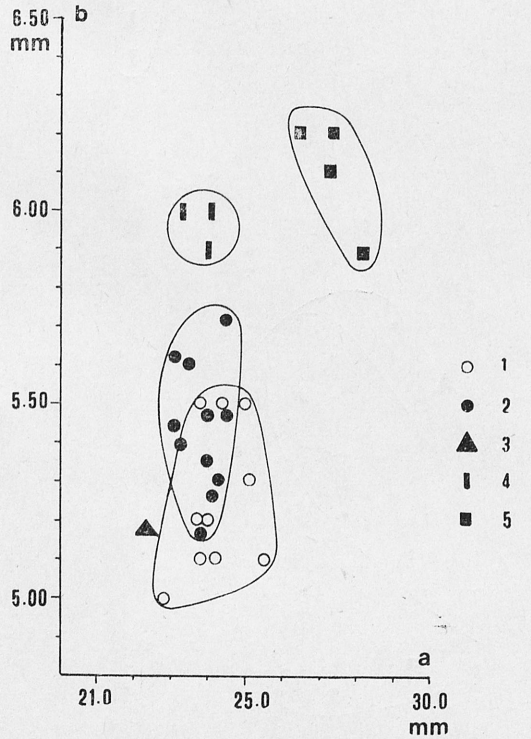

Fig. 2. Ratio of total length of skull (x-line) to interorbital breadth (y-line) in different forms of vampires. 1 — *Desmodus rotundus rotundus* (after Husson, 1962), 2 — *D. r. murinus*, 3 — *D. r. puntajudensis* n. ssp., 4 — *Diaemus youngi* (after Husson, 1962), 5 — *Desmodus stocki* (after Jones 1958)

anterior margins of the orbitae 5·95, height of jugal arch in the middle part 1·07, distance from the posterior border of palatinum to the basion 9·69, distance from the posterior border of palatinum to the condylus 12·25.

SYSTEMATIC POSITION OF THE DESCRIBED FORM IN THE GENUS *DESMODUS*

In the recent fauna *Desmodontidae* are represented by three genera: *Desmodus*, *Diaemus* and *Diphylla*, each with one species (MILLER 1907, HALL & KELSON 1959). In all three species incisors and canines are strongly developed and adapted

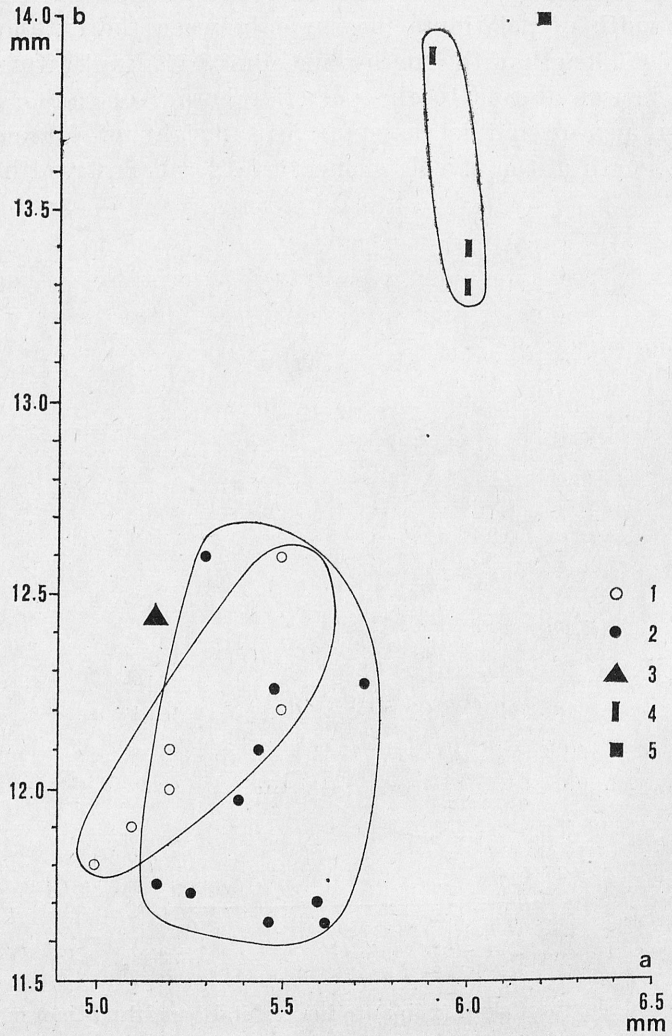

Fig. 3. Ratio of interorbital breadth (x-line) to greatest width of jugal arches (y-line) in different forms of vampires. For explanations see fig. 2

for cutting the skin of vertebrates. Important differences can be seen in the degree of reduction of the dentition, reaching its highest grade in *Desmodus*:

$$\text{I } 1/2,\ \text{C } 1/1,\ \text{Pm } 1/2\ \text{M}1/1 = 20$$

The dental formel in the specimen from Punta Judas agrees with this in the genus *Desmodus*. Besides, the described specimen differs from the genera *Diphylla* and *Diaemus* in many other characteristics, most important of which are: more subtle construction of the interorbital bridge (Text-figs. 2—4) and different, typical for the genus *Desmodus*, development of jugal arches. All this points clearly to the membership of our specimen in the genus *Desmodus*.

In the genus *Desmodus* one extant species, *D. rotundus*, with two subspecies: *D. r. rotundus* and *D. r. murinus*, as well as two fossil species: *D. stocki* JONES 1958 and *D. magnus* GUT 1959 were described. Both fossil species can be excluded from further comparisons with our specimen because of their much larger dimensions. They are above the range not only of the form from Punta Judas, but also of recent forms (Table II).

From recent species the specimen from Punta Judas differs in above mentioned details of cranial morphology. Most important is here more delicate appearance of the skull, different construction of the jugal arches, relatively longer brain case and different development of foramen occipitale magnum (Table II and text-fig. 3). These differences are, in the opinion of the authors, sufficient for the erection of a new subspecies.

COMPARISON WITH OTHER FORMS OF VAMPIRE BATS

The distribution of vampire bats is to-day limited to South and Middle America. In the south they reach Uruguay and northern Argentine (VILLA B. R. & M. VILLA CORNEJO 1967, WALKER 1968, ACOSTA y LARA 1950, 1959), in the north Central Mexico (ALLEN 1935, ALVAREZ 1963, northern coast of Venezuela and Trinidad (GOODWIN & GREENHALL 1961). They are absent from the Antilleans (HALL & KELSON 1959). Recently MCNAB (1973) stated, that the isotherm +10° C of the coldest month of the year determinates the border of their distribution, physiological aspects beeing the limiting factor: in lower temperatures the animal needs more food to maintain its stable body temperature than it can take.

In the Pleistocene the areal of distribution of the vampire bats was considerable larger than to-day. Their remains were discovered in the cave sediments of this age in the Middle and South America (FLINT 1972, MARTIN 1972). In Mexico they were reported from Josecito Cave, Nuevo León (ALVAREZ 1965, CUSHING 1945, JONES 1958) and from Tlapacoya (ALVAREZ 1972), in U.S.A. from Potter Creek Cave in California (HUTCHISON 1967). Fossil remains of vampire bats are also known from Sabertooth Cave and Haile in Florida (GUT 1959, OLSEN 1960).

The remains of vampire bats from Mexico and California were described as a new species *Desmodus stocki* JONES 1958, whereas those from Florida under the name *Desmodus magnus* GUT 1959. According to some authors (HUTCHISON 1967, MARTIN 1972) both continental forms belong to one species, i.e. *Desmodus stocki* JONES.

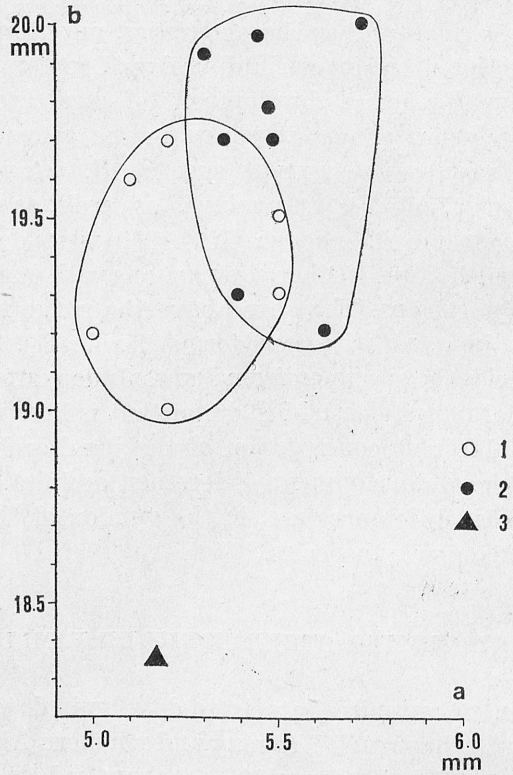

Fig. 4. Ratio of interorbital breadth (ab) to length from condyle to the front of canine (coordinate) in different forms of vampires. For explanations see fig. 2

COCKERELL (1930) reports *D. rotundus* from a cave in Terlington, Texas, determining the age of the layer where it was found as Late Pleistocene. HATT et all. (1953) mention the presence of *D. rotundus* in Lotum Cave on Youcatan (Mexico), reporting them as subfossil. MARTIN (1972, p. 326) in his review of fossil bats of America notes that a description of a new species of fossil vampire bat from Venezuela is in preparation.

The only up-to-date known fossil locality of a vampire bat in West India is the cave Lamas near Habana (ARREDONDO 1958), where one damaged skull was found. This specimen was later determined and described by KOOPMAN (1958) as *Desmodus rotundus murinus*. Punta Judas is therefore the second locality of vampire bats on the Antilleans.

In the case of Punta Judas specimen, its membership in the species *Desmodus rotundus* is beyond doubt and, as stated above, existing differences against

recent populations are of subspecific character. The problem of systematic position of the specimen from Lamas Cave, described by KOOPMAN (1958) is still open. It is a badly damaged skull and many measurements, important for determination of its character, cannot be taken. According to GUT (1959) this specimen belongs to *Desmodus magnus*. We were able to study the original of the photograph published in the cited paper of KOOPMAN, made us accessible through the courtesy of Mr. G. SILVA TABOADA. On the base of this photograph it can

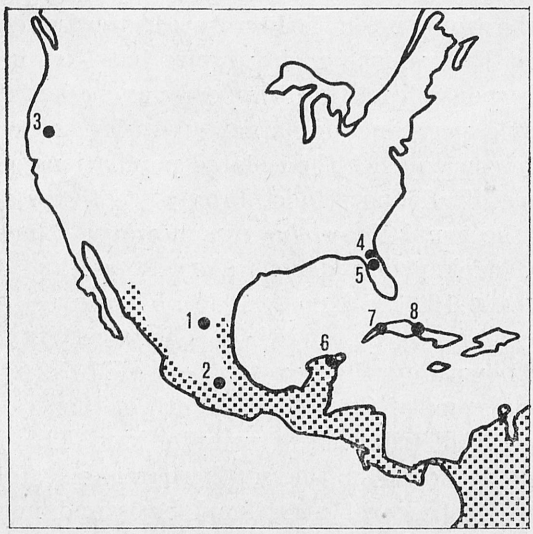

Fig. 5. Recent distribution of *Desmodus rotundus* in the Middle America and fossil and subfossil localities of vampires from the genus *Desmodus* (partly after ALVAREZ 1972, MARTIN 1972 and MCNAB 1973). 1 — *Desmodus stocki*, San Josecito, Mexico (JONES 1958), 2 — *D. stocki*, Tlapacoya, Mexico (ALVAREZ 1972), 3 — *D. stocki*, Potter Creek Cave, California (HUTCHISON 1967), 4 — *D. magnus*, Florida (GUT 1959), 5 — *D. magnus*, Florida (OLSEN 1960), 6 — *D. rotundus*, Lotum Cave, Mexico, subrecent (HATT et all., 1953, 7 — *D. cf. rotundus*, Cueva Lamas, Cuba (KOOPMAN 1958), 8 — *D. rotundus puntajudensis* n. ssp., Punta Judas, Cuba

be stated that in accordance with KOOPMAN'S supposition this specimen belongs to *Desmodus rotundus*. Unfortunately the identity of KOOPMAN'S specimen with our material cannot be stated. The skull from Lamas Cave is probably Pleistocene in age whereas this from Punta Judas is much younger and can, in all probability, be dated for the Holocene climatic optimum, i.e. about 5·5—3 thousand years b.C. (MAYO 1970).

Two alternative explanations are therefore possible:

1. Both specimens (from Lamas and Punta Judas) represent one form, which inhabited Cuba during a long period and became extinct in the Holocene.

2. Both specimens belong to different populations which inhabited Cuba one after another in different periods of time *.

* The possibility of migration of isolated specimens from the continent and its preservation in fossil state seems to be negligible.

The first of the above mentioned explanations seems to be more probable, though there are no proves that there was not a late, postglacial migration of vampires from the continent to Cuba.

Vampire bats are strictly specialized in their feeding habits, eating exclusively the fresh blood of larger mammals and birds. The extinction of vampires in North America and on the Antilleans could be in connection, according to many opinions (Arredondo 1958, Cauto 1967, Koopman 1958, Olsen 1960) with the extinction, at the end of the Pleistocene, of their natural pray represented by large terrestrial edentates. There is the argument in the literature as to what degree the extinction of edentates brought the vanishing of vampire bats, or, in the contrary, the vampire bats were responsible for the disappearance of edentates. There are many cases known of cattle perishing on large territories caused undoubtfully by vampire bats. In the consequence the isolated populations of vampires can also perish in the absence of adequate food. From the other side it is known that vampire bats from the genus *Desmodus* can, however reluctantly, feed on the blood of birds, e.g. chicken or pidgeons (Acosta y Lara 1959, Allen 1935, Ditmars & Greenhall 1935, Sanborn 1949). There was, therefore, on Cuba, a nutritional reserve guaranteeing the existence for a certain time of a population of vampires. As we known from the investigations of McNab (1973), the lowering of the medium temperature of the coldest month of the year below $+10°C$ can be a factor limiting the distribution of vampire bats. This explains why these animals were unable to settle in the southern regions of the United States, notwithstanding the existence of nutritional basis and notwithstanding their ability to live in human habitations. On Cuba the temperature fluctuated in rather broad limits and it is possible that after the climatic optimum in the Holocene, at scarce possibilities of feeding, their further existence was impossible.

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STRESZCZENIE

W jaskini Centenario de Lenin znajdującej się w Loma del Medio, Punta Judas, na północno-wschodnim wybrzeżu prowincji Las Villas na Kubie znaleziono brekcję kostną zawierającą liczne szczątki ssaków. Osady w jaskini

tworzyły dwie warstwy, z których górna, datowana na środkowy holocen, składała się z licznych kości scementowanych aragonitem. Znaczna część brekcji wydobytej z tej jaskini, została uprzednio opracowana przez N. Mayo (1970). Pozostała część znajdowała się w Instytucie Geologicznym Kubańskiej Akademii Nauk i opracowano ją w r. 1973, znajdując następujące gatunki ssaków: *Nesophontes micrus*, *Geocapromys columbianus*, *Boromys terrei* i *Macrotus waterhousii*, jak również czaszkę *Desmodus rotundus*, którą opisano jako przynależną do nowego podgatunku *Desmodus rotundus puntajudensis* n. ssp.

Ten nowy podgatunek różni się od żyjących obecnie delikatniejszą budową i mniejszymi rozmiarami, jak również odmiennym wykształceniem łuków jarzmowych i otworu potylicznego. Autorzy dyskutują pozycję systematyczną opisanego podgatunku i porównują go z gatunkami kopalnymi z rodzaju *Desmodus*.

Dyskutowany jest problem, w jakim okresie nastąpiło wymarcie wampirów na Kubie. Autorzy sądzą, że możliwe było, mimo zmniejszenia się pod koniec plejstocenu terytorium zamieszkanego w Ameryce przez wampiry, przeżycie niewielkiej populacji tych nietoperzy na Kubie aż do środkowego holocenu. Porównano nowy podgatunek z opisem kopalnego okazu wampira z jaskini Lamas na Kubie (Koopman 1958). Znaczny stopień uszkodzenia okazu z Lamas nie pozwala na określenie jego pozycji systematycznej, chociaż Koopman zaliczył go do *Desmodus rotundus murinus*. Jeżeli jednak wampiry zasiedlały Kubę w plejstocenie i przeżyły do optimum klimatycznego w środkowym holocenie, to można sądzić, że okazy z Punta i Lamas mogą reprezentować ten sam takson.

RESUMEN

En la Cueva del Centenario de Lenin, situada en la Loma del Medio, Punta Judas, en la costa noreste de la Provincia de Las Villas, Cuba, se descubrió una brecha ósea contentiva de restos de mamiferos, en la cual se distinguen dos capas. La capa superior, cuya edad ha sido datada como Holoceno Medio, estaba compuesta por numeros huesos cementados por aragonito.

La parte principal de la mencionada brecha fue alaborada con anterioridad (Mayo 1970). La parte restanta fue depositada en el Instituto de Geologia de la Academia de Ciencias de Cuba, y elaborada en 1973, determinándose en ella las siguentes especies de mamíferos: *Nesophontes micrus*, *Geocapromys columbianus*, *Boromys torrei*, y *Macrotus waterhousii*, asi como un craneo de *Desmodus rotundus*, el cual se describe como una nueva subspecie *Desmodus rotundus puntajudensis* n. ssp.

La nueva subspecie se distingue de las actuales por una estructura mas delicata y menor tamaño, asi como por la diferente estructura de los arcos

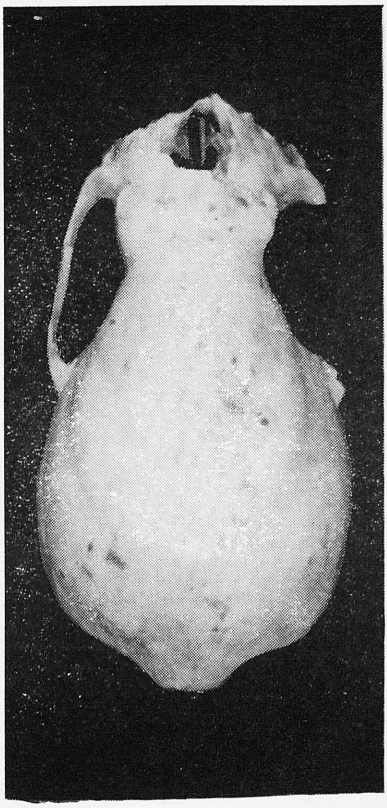
cigomáticos y del foramen occipital. Los autores discuten la posición sistemática de la subspecie descrita, y la comparan con especies fósiles del género *Desmodus*. Se discute el problema del momento en que tuvo lugar la extinción de los vampiros en Cuba. Los autores opinan que es posible que, con posterioridad a la reducción del área que los vampiros ocupaban en el continente (mucho más extensa hacia el norte en otro tiempo), sobreviviera en Cuba una pequeña población de vampiros después del Pleistoceno.

Se compara la nueva subspecie con la descripción dada por KOOPMAN (1958) de un ejemplar fósil de vampiro de la Cueva Lamas en Cuba. La mala conservación del ejemplar de Lamas no permite la determinación exacta de su posición sistemática, aunque KOOPMAN lo refirió a *Desmodus rotundus murinus*. No obstante, si los vampiros existieron en Cuba durante el Pleistoceno y hasta el óptimo climatico del Holoceno, habria que concluir que los ejemplares de Lamas y de Punta Judas representan el mismo taxon.

Plate XI

Desmodus rotundus puntajudensis n. ssp.

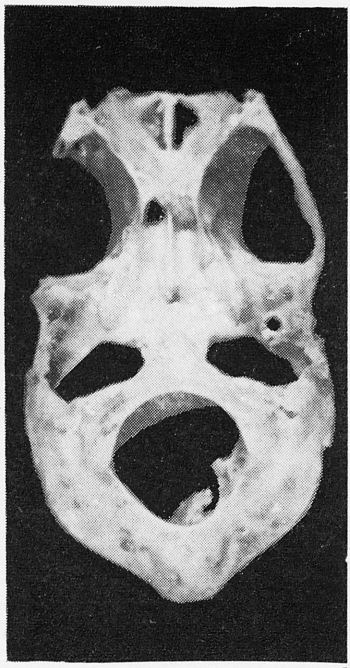
1. — norma verticalis
2. — norma basilaris
3. — norma lateralis
4. — foramen occipitale magnum



1

2

3



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