

CARTERODON, A LIVING-FOSSIL RODENT OF BRAZIL

M. FRIANT

Professor at the School of Anthropology, Paris

ABSTRACT—*Carterodon sulcidens* Lund 1841, Rodent (*Echimyinae*), at once known from the Pleistocene strata of Brazil (Lagoa Santa caves), is yet living, though very rare, in that country.

It is an interesting mammal, with strange jugal teeth formula: Mt4, M1, M2, M3, and some characters of the limbs skeleton (described, here, for the first time) that, frequent in rodents, are not, however, the rule.

INTRODUCTION

In the year 1841, W.P. Lund described numerous fossil remains of *Carterodon* (that he called *Echmys sulcidens*) found in the Pleistocene strata of the Lagoa Santa caves (Brazil).

It was only in 1851 that J. Reinhardt told of *Carterodon* yet living in Brazil, where it is very rare.

In the Zoological Museum of Copenhagen University, I studied the Pleistocene teeth and bones of the Lagoa Santa's *Carterodon* and the osteology of some actual specimens of Brazil.

CARTERODON

The Brazilian *Carterodon* admits only one species, *Carterodon sulcidens* Lund. It is a Rodent of the South-American *Echimyidae*' family (J. R. Ellerman, 1940) and the *Echimyinae*'s subfamily.

1. GENERAL CHARACTERS

Rather small sized, terrestrial, suit to fossorial life, fur soft (bristly, the most often, in

Echimyinae). Tail short and well haired. Posterior feet narrow and long. Claws moderate.

2. BONY HEAD (fig. 1)

Nasals broad. Zygomatic region broadened with moderate process on posterior lower border. Jugal thickened anteriorly. Supra-orbital ridges developed and slight interorbital constriction. Bullae prominent, but not extremely.

Mandible strong, angle developed; coronoid process not very higher than condyle.

3. DENTITION (fig. 2)

The *Carterodon* has the dental formula of the *Echimyinae*: 1/1 I, 1/1 Mt, 3/3 M (M. Friant, 1936). The incisors are broad, the upper ones, short and grooved, with a sulcus near the external border and another, not so clear but wider, near the medial plane of the tooth, internal in reference to it. This character is

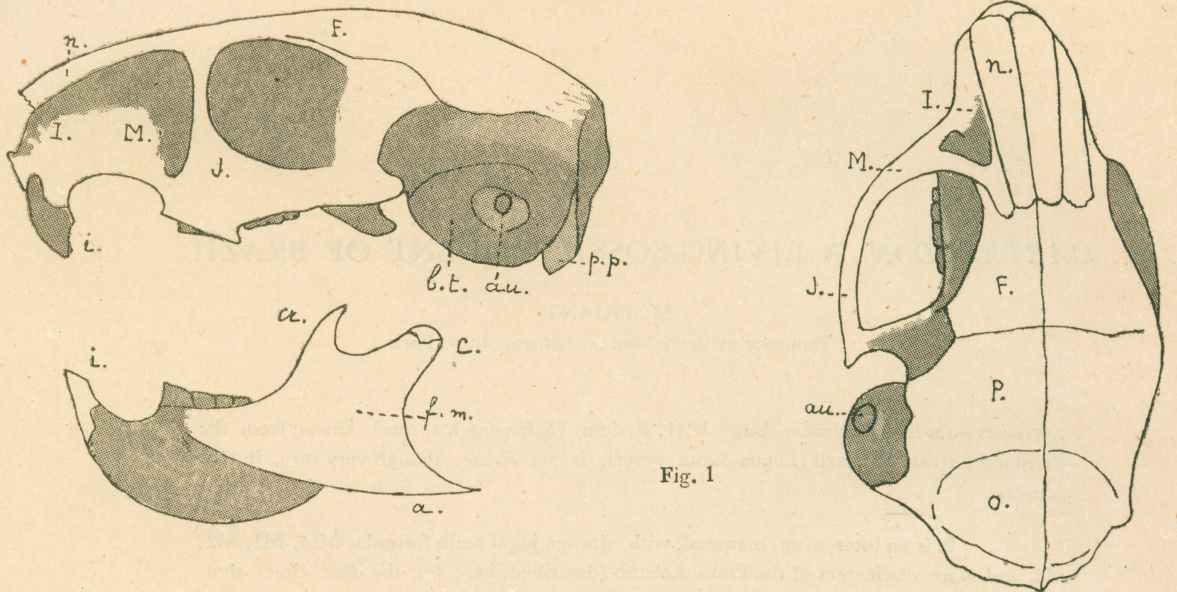


Fig. 1

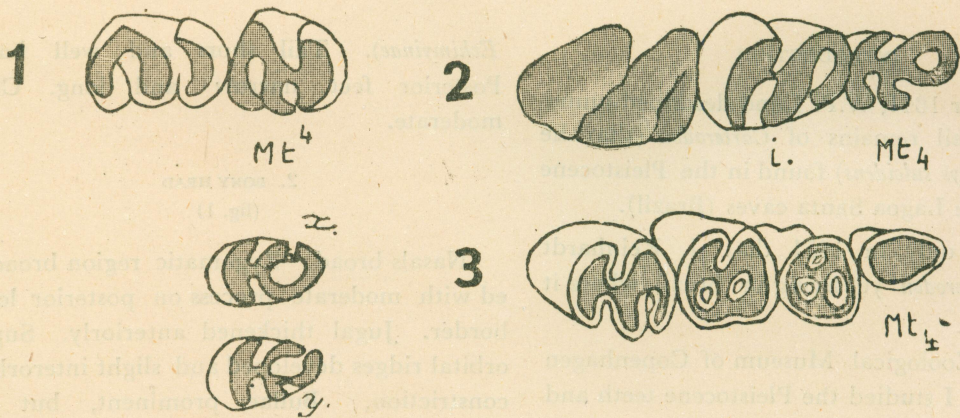


Fig. 2

FIG. 1. *Carterodon sulcidens* Lund. Actual adult of Brazil, No 591 Univ. Mus. Copenhagen. *Skull with mandible.*

On the left: left lateral face.

On the right: upper surface of cranium, a little laterally seen (on the left).

a. angle. *au.* external auditory orifice. *b.t. du.* tympanic bulla. *C.* condyle. *cr.* coronoid process. *F.* frontal. *f. m.* fossa for the masseter. *I.* intermaxilla. *i.* incisors (upper and lower). *J.* jugal. *M.* maxilla. *n.* nasal. *O.* occipital. *P.* parietal. *p.p.* parieto-occipital process.

About natural size.

FIG. 2. *Carterodon sulcidens* Lund, of Brazil. Univ. Mus. Copenhagen.

1. Young exemplar actual, of Brazil. Upper left molars, Mt^4 and M^1 , little worn.

2. and 3. Fossil exemplars of Lapa de Escrivania, No 5, Lagoa Santa.

2. Lower left molars, Mt_4 M_1 M_2 (not yet worn), of a young animal.—Above: isolated Mt_4 ; *x*, from H. Winge, and *y*, both less worn than Mt_4 of the dental series, same setting.

3. Series of the lower left molars, Mt_4 — M_3 , of an adult animal.

1 and 2: about 7 times natural size. 3: about 5 times natural size.

the sole among the *Echimyinae*. The anterior face of the tooth is orange except along its internal border, where it is white. The lower incisors, by their end, project till the inferior dental canal, in the wall of which, they form a slight prominence.

All the *molars*, Mt4, M1, M2, M3, when unworn, have 3 transverse crests (fig. 2, 1, 2). The two posterior crests of the *upper* molars are joined in a V, on the internal side and, in proportion to the marked inversion of the opposite teeth of the *Echimyinae*: the two anterior crests of the *lower* molars are joined in a V, on the external side (M. Friant, 1954), except at Mt4, where the anterior crest, first independent (H. Winge, 1888, Pl. VIII, 9 et fig. 2, 2x of the present study), joins the 2d, inside, then outside, and forms an early and very short intermediate tube.

The *milk molars*, persisting the whole life, are not very smaller than the true molars; the lower one, not very elongated, is clearly narrower.

For all the molars, the transverse crests are also joined at different levels (from the original face of mastication), so that are formed 3 *sinuses* (1 external, 2 internal, at the true inferior molars, for instance), conspicuous by wear; next, 3 *intermediate tubes*, not very deep, that have disappeared on the teeth strongly worn out (fig. 2, 2, 3).

4. OSTEOLOGY OF THE LIMBS

The studied skeleton (for the long bones) is the one of a living young *Carterodon* and, for that reason, we give no mensurations.

A. THORACIC LIMB

(a) *The shoulder girdle* (fig. 3, 1)

The *scapula* (Sc.), high and widened downwards, has a *marked coracoid process*. The

acromioscapular notch is so deep that the spine only occupies a short space near the scapula border and is completed by a long and slender *acromion*. The scapula, by its morphology, is near the one of *Proechimys*, terrestrial runner, among the *Echimyinae* (T. Tullberg, 1899, Pl. XXX, 10). Yet, in the last one, the acromion is bounded by two divergent processes: the outer articulates with the clavicle, the inner being the "metacromion". In proportion to the young age of our subject, it is possible that the metacromion be not yet ossified.

The *clavicle* (Cl.) is long and sigmoid.

(b) *The humerus* (fig. 3, 2)

The specimen is young and the lower epiphysis is not yet united to the shaft.

The humerus is long and rather slender, with a rounded head. The tuberosities (the lower, t_2 , especially) are prominent. There is a *supracondylar foramen* (f.s.).

(c) *The radius and the ulna* (fig. 3, 3)

Distinct, as generally in the Rodents, they are near one another and curved outside. The ulna (c.) is very much developed.

(4) *The carpus* (fig. 4)

The *proximal row* of the carpus is formed by the *scapho-lunar* (Sc.L.: the scaphoid and lunar are united as, generally, in Rodents), the *cuneiform* or *pyramidale* (P.) and the *pisiform bone* (p., ulnar sesamoid bone) most enlarged.

The *distal row* contains a radial sesamoid bone (sometimes, named *praepollex* (*)), the *trapezium* (T.), the *trapezoid* (t.), the *magnum* (M.) and the *unciform* (cr., resulting of the constant union of the 4th and 5th carpals).

Between the two carpal rows, there is a *centrale* (c.), as, often, in the Rodents.

The anterior foot has 5 *metacarpal bones*; the first is shorter than any of the others.

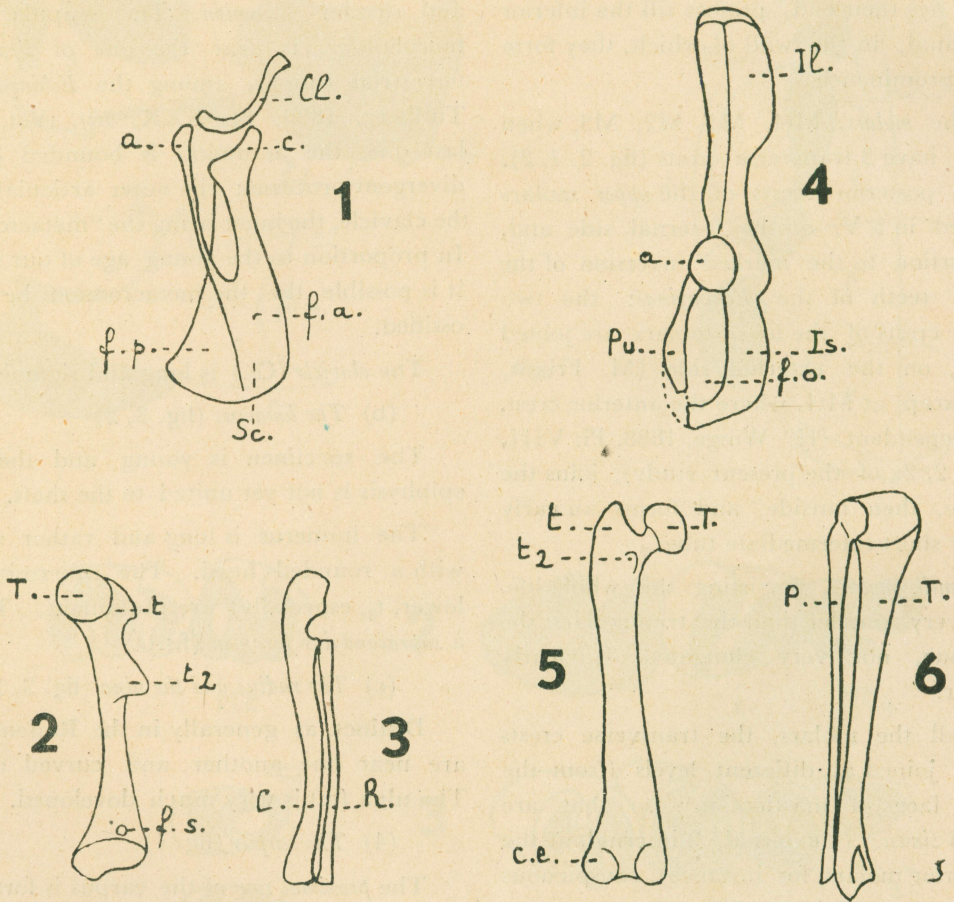


Fig. 3

FIG. 3. *Carterodon sulcidens* Lund. Young animal actual, of Brazil, Lagoa Santa, No 188 Univ. Mus. Copenhagen. *Bones of the limbs, left side. Schemes.*

1. *Shoulder girdle, posterior face.* a. acromion. c. coracoid process. Cl. clavicle. f.a. anterior fossa, f.p. posterior fossa of the scapulum (Sc.).

2. *Humerus, without the inferior epiphyse, internal face.* f.s. supracondylar foramen. T. head. t_1 , t_2 , trochanters.

3. *Radius (R.) and ulna (C.), posterior face.*

4. *Pelvic girdle, external face.* a. acetabulum. f.o. obturator foramen. Il. ilium. Is. ischium. Pu. pubis.

5. *Femur, posterior face.* c.e. outer condyle. t. great trochanter. t_2 small trochanter. T. head.

6. *Tibia (T.) and fibula (P.), posterior face.*

About 1 time $1\frac{1}{2}$ natural size.

Each metacarpal supports a *digit*, the 1st or *pollex*, with 2 phalanges only, is the shortest.

B. PELVIC LIMB

(a) *The pelvic girdle* (fig. 3, 4)

The subject being young, the pubis, still partly cartilaginous, is not joined to the ischium, on the dry piece.

The *ilium* (Il.) is elongated; the *pubis* (Pu.) and the *ischium* (Is.) are developed, flat, diverging posteriorly; the *obturator foramen* (f.o.) is of considerable size. The condyloid cavity or *acetabulum* (a.) is cup shaped.

(b) *The femur* (fig. 3, 5), long and slender, has no 3rd trochanter, but a great trochanter (t.) much developed.

(c) *The slender fibula* (fig. 3, 6, P.) is separated of *the tibia* (T.) by an interosseous space, except at the extremities.

(d) *The tarsus* (fig. 5).

The *proximal row* consists of two bones: the *astragalus* or talus (Ta., which, according to Gegenbaur's view represents the coalesced scaphoid and lunar of the hand) and the *calcaneum* (C.).

The *navicular bone* (n.) is interposed between the proximal and the distal row, on the inner or tibial side, but, on the outer side, the bones of the two rows come into contact.

The *distal row* consists of four bones, which, beginning on the inner side, are: the *three cuneiform bones*, internal (c_1), middle (c_2), very small, and external (c_3), and the *cuboid* (cb.). There is a large *sesamoid bone* (*), on the tibial side of the tarsus, articulating with the astragalus, navicular and internal cuneiform.

The posterior foot has 5 *metatarsal bones* and 5 *digits*.

5. CONSIDERATIONS ON THE MOLARS

The *formula* of *Carterodon's* jugal teeth: Mt4, M1, M2, M3, is the formula of the *Echimyinae*. Mt4, not replaced by P4, becomes permanent (M. Friant, 1954). The Rodents of this group have, then, lost their only premolar; it is a character of evolution.

However, on the other hand, the *Carterodon* molars, with merely 3 transverse crests, are rather primitive. We might recall that the *archaic molar type*, tuberculated, in the Eocene *Paramys* of North-America (3 longitudinal rows of 2 tubercles, at the upper molars-2 longitudinal rows, only, of 2 tubercles, at the lower molars) (M. Friant, 1934 and 1960), becomes at 2 *transverse* crests in *Sciuroides* (upper Eocene Period of Europe) by the transverse union of the anterior and the posterior tubercles. Numerous *Sciuridae*, especially *Citellus* (from the Miocene Period to the present time), have, at their upper molars, 3 *transverse crests*: the 2 posterior ones, united in a V, on the internal side, are the original crests, as it is shown, in the young animal, by the calcification (M. Friant, 1951). At the upper molars of *Carterodon*, the crests' state is the same as in *Citellus*; but, the lower molars (yet with 2 crests, in the Sciurid) have the same morphology as the upper ones (3 crests, of which 2 united in a V), only inverted from before to behind and from outside to inside.

Paramys, *Sciuroides*, *Citellus*, *Carterodon* show the first stadia of the molars' complication in the Rodents.

Moreover, the jugal teeth of *Carterodon* present, already, other evolution's characters:

- (1) The equalization, in breadth, of the lower molars with the upper ones.
- (2) The total inversion of the antagonist teeth.

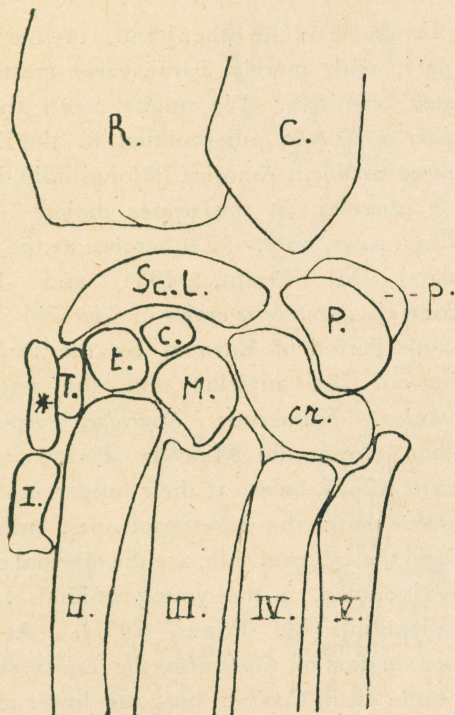


Fig. 4

FIG. 4. *Carterodon sulcidens* Lund. Adult animal, actual of Brazil, No 21.9.89 Reinhardt, Univ. Mus. Copenhagen. Bones of the left carpus. Scheme.

C. cubitus. c. centrale. cr. unciform. M. magnum. P. pyramidale. p. pisiform. R. radius. Sc.L. scapho-lunar. T. trapezium. t. trapezoid. * radial sesamoid bone (*praepollex*). I, II, III, IV, V, metacarpal bones.

About 8 times natural size.

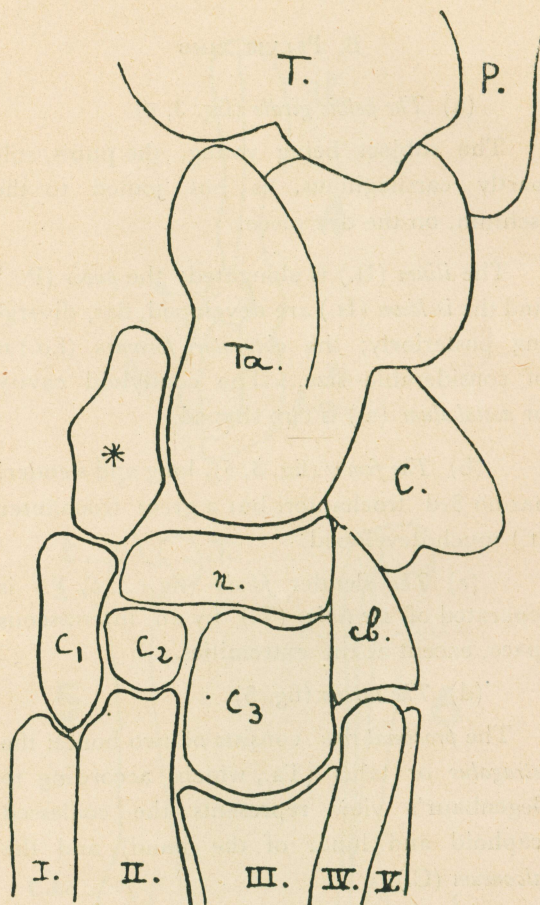


Fig. 5

FIG. 5. *Carterodon sulcidens* Lund. Adult animal, actual of Brazil, same specimen as in figure 4. Bones of the left tarsus. Scheme.

C. calcaneum. c₁, c₂, c₃, cuneiform bones. cb. cuboid. n. navicular bone. P. fibula. T. tibia. Ta. talus. * tibial^{*} sesamoid bone. I, II, III, IV, V, metatarsal bones.

About 8 times natural size.

- (3) The tendency of Mt_4 to grow longer, although with 3 crests only, as the true molars.
- (4) A beginning of hypselodonty, with "intermediate tubes" (isles of english authors).

The persisting Mt_4 , rare among the Rodents, exists, not only in *Carterodon* and the other *Echimyinae* but also in the African *Thryonomyidae* (M. Friant, 1945) and in the *Spalacidae* of the old World (H. G. Stehlin, 1922).

Among the pleistocene and actual *Echimyinae*, all from Brazil, *Euryzygomatomys*, suit also to fossorial life, by its molars' morphology, comes nearer *Carterodon*.

SUMMARY

The pleistocene and actual *Carterodon* of Brazil admits a single species, *Carterodon sulcidens* Lund. It is a Rodent of the *Echimyinae*' group, of which it possesses the jugal teeth's formula: Mt_4, M_1, M_2, M_3 . It is characterized, above all, by its *grooved upper incisor*, all its molars with 3 original transverse crests and its *broad zygomatic arch*.

Its limbs' skeleton presents some interesting dispositions on the level with the *shoulder girdle* (acromion), the *carpus* (scapho-lunar, os centrale and radial sesamoid bone) and the *tarsus* (smallness of the middle cuneiform, presence of a sesamoid bone), that, frequent in the Rodents' Order, are not however a rule.

RÉSUMÉ

Le *Carterodon pléistocène* et actuel, du Brésil ne comporte qu'une seule espèce, *Carterodon sulcidens* Lund. C'est un Rongeur du groupe des *Echimyinae*, dont il possède la formule dentaire jugale: Mt_4, M_1, M_2, M_3 . Il est surtout caractérisé par son *incisive supérieure cannelée*, ses molaires, toutes à 3 crêtes

transverses, à l'origine, et son *arcade Zygomaticque élevée*.

Le squelette de ses membres présente quelques dispositions intéressantes, au niveau de la *ceinture scapulaire* (acromion), du *carpe* (scapho-lunaire, os central et os sésamoïde radial), et du *tarse* (petitesse du 2e cunéiforme et présence d'un os sésamoïde tibial), qui, fréquentes dans l'Ordre des Rongeurs, ne sont pas, cependant, de règle.

REFERENCES

- BURMEISTER, H., 1854, Systematische Übersicht der Thiere Brasiliens welche während einer Reise durch die Provinzen von Rio de Janeiro und Minas geraës. Erster Theil, Säugethiere (*Mammalia*), Berlin, G. Reimer. X+342 p. (pp. 209-211).
- ELLERMAN, J.R., 1940, *The families and genera of living Rodents*. 1. Rodents other than *Muridae*. British Museum N. H. : 125-126.
- FLOWER, W.H., 1876, *An introduction to the osteology of the Mammalia*. 2d Ed. London, Macmillan. 344, p.
- FRIANT M., 1934, Le type primitif des molaires supérieures chez les Rongeurs. *C. R. Acad. Sci. Paris*. **199**: 1145.
- , 1936, Interpretation des dents jugales chez les Lonchérinés, *Vidensk. Medd. Dansk. naturh. Foren.* **99**: 263-266.
- , 1945, La formule dentaire des Rongeurs de la famille des *Thryonomyidae*. *Rev. Zool. Bot. africaines*. **38**: 200-205.
- , 1951, La morphologie des molaires d'un Rongeur, le Spermophile (*Citellus*). *C. R. Acad. Sci. Paris*. **232**: 1509.
- , 1954, Sur les Rongeurs fossiles de Lagoa Santa, Minas geraes, Bresil. *Vidensk. Medd. Dansk. naturh. Foren.* **116**: 233-250.
- , 1960, Les Rongeurs de la famille des *Sciuridae*. Interprétation de leurs molaires. *Bull. G. I. R. S. en Stomatologie*. **3e** année 419-434.
- , 1962, Les *Echimyinae*, (*Echimyidae* Rongeurs) du Pléistocène de Lagoa Santa, Bresil. Interprétation de leurs molaires. *Acta. anatom.* **51**: 95-111.
- LUND, P. W., 1841, Blik paa Brasiliens Dyreverden för sidste Jordomvaeltning. III. Fortsoettelse af Pattedyrene. *Kgl. Danske Vidensk. Selsk. naturvid. math.* (4) **8**: 98-289.

- LUND, P. W., 1950, Memorias sobre a Paleontologia brasileira. Etude revue et commentée par C. Paula Couto. Rio de Janeiro.
- , 1842, Fortsatte Bemaerkninger over Brasiliens uddöde Dyrkabning. *Kgl. Danske Vidensk. Selsk.* (4) 9: 136.
- REINHARDT, J., 1851, *Bekrivelse af Carterdnlunocsedso.* (Lund). *Vidensk. Medd. fra den naturh. For i Kjöbenhavn*: 22-26.
- STEHLIN, H.G., 1922-1923, *Rhizospalax Poirrieri* Miller a. Gidley und die Gebissformen der Spalaciden. *Verhandl. Naturf. Gesellsch. in Basel.* 34: 233-263.
- TATE, G. H. H., 1935, The Taxonomy of the genera of neotropical Hystricoid Rodents. *Bull. Amer. Museum N. H.* 68: 295-447.
- TULLBERG, T., 1899, Ueber das System der Nagethiere. *Nova acta R. Soc. Sci. Upsalensis*: 1-328.
- WATERHOUSE, G.R., 1846-1848, *A natural history of the Mammalia.* 2: Rodentia. London, H. Baillière, 351-354.
- WINGE, H., 1888, Jordfundne og nulevende Gnavere (*Rodentia*) fra Lagoa Santa, Minas geraës, Brasilien. *Med. Udsigt over Gnavernes indbyrdes Slaegtskab (E Museo Lundi, I)*: 1-178.