FOSSIL MAMMALS FROM THE BEGINNING OF THE CENOZOIC IN BRAZIL

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CONDYLARTHRA, LITOPTERNA, XENUNGULATA, AND ASTRAPOTHERIA

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INTRODUCTION

THIS PAPER IS THE FOURTH preliminary report on the fossil mammals from the Paleocene of São José de Itaborai, State of Rio de Janeiro, Brazil. The final report, which will include detailed descriptions of all the mammalian groups represented in São José de Itaborai, will be published by the Museu Nacional, Rio de Janeiro, in collaboration with the Divisão de Geologia e Mineralogia do Departamento Nacional da Produção Mineral. Completion of the final report will take considerable time, and for this reason I have decided to present a series ofpreliminary reports on the results of my investigations of the different groups involved.

All the material here described has been collected in a limestone quarry at São José de Itaborai, State of Rio de Janeiro, some miles northeast of Niteroi, the capital of the state, and on approximately the same latitude as the city of Rio de Janeiro. This quarry is under the management of the Companhia Nacional de Cimento Portland (Mauá), which has given generous cooperation in the work of collecting, and to which I present my thanks for this help.

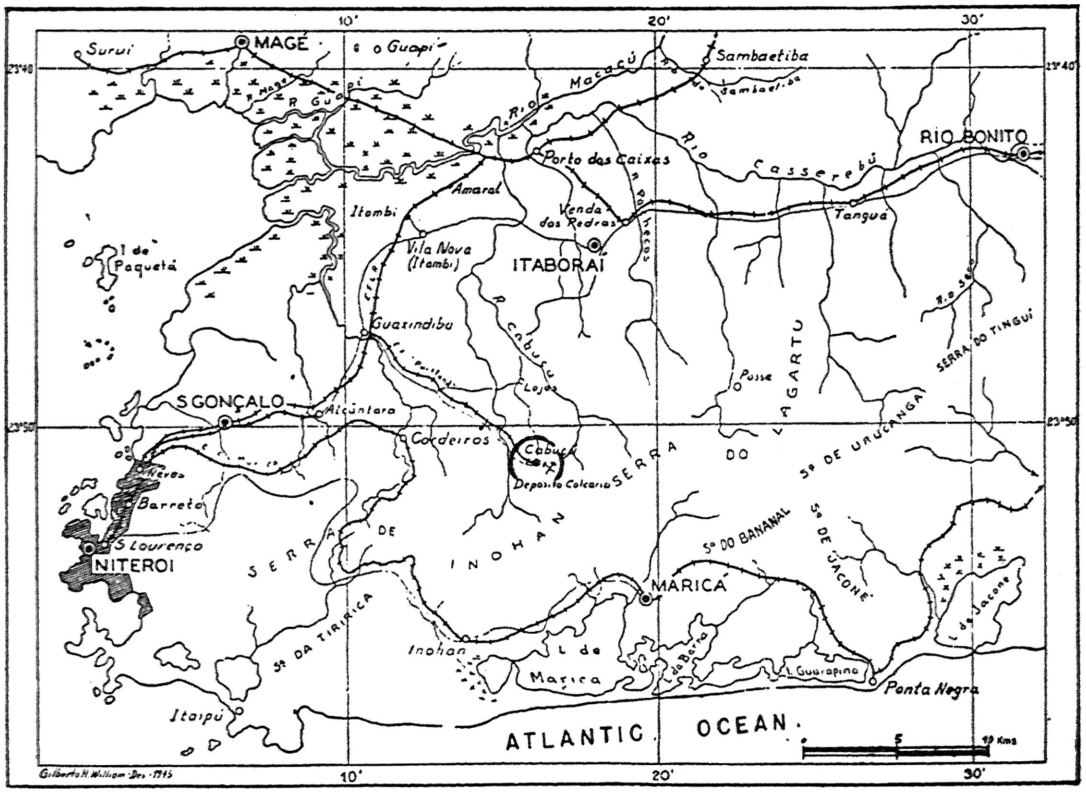


FIG. 1. Map of part of the State of Rio de Janeiro, Brazil, showing the locality of the limestone quarry of São José de Itaborai (circle near the center). The latitudes are referred to the meridian of the city of Rio de Janeiro. Adapted from Price and Paula Couto, 1950.

A note and bibliography on the geology of this deposit were given by the author in an earlier paper (1949).

The fossil vertebrates came from channels and underground caves produced in the limestone by pluvial and underground water. As they are definitely more primitive than the corresponding groups in the Casamayoran (*Notostylops* beds-lower Eocene) of Patagonia, and as one of the genera here consid-

ered (*Carodnia*) is known elsewhere only in the Rio Chican (upper Paleocene) of Patagonia, it seems to me that they must be considered as of Paleocene age, synchronous with the Rio Chican.

The limestone is perhaps older than the fossiliferous marl which fills the channels and underground caves. At any event it is not more recent than the Rio Chican. Its age, and consequently the age of its invertebrate fauna as described by Maury (1935), is possibly lower Paleocene or upper Cretaceous, at least in part (some of the vertebrate specimens were found in the white and gray limestone).

These studies were greatly aided by the opportunity of direct comparison between the Paleocene remains from São José de Itaborai and the specimens in the rich collection of the Patagonian and North American lower Tertiary groups in the American Museum of Natural History. This was made possible by the generous support given me by the John Simon Guggenheim Memorial Foundation, in New York, to which I offer my best acknowledgments. I also wish to thank the General Secretary of that foundation, Mr. Henry Allen Moe, for the kind attention and courtesy which I have invariably received from him.

To Dr. Matias G. de Oliveira Roxo, former director, and Dr. Alberto Ribeiro Lamego, present director, of the Divisão de Geologia e Mineralogia do Departamento Nacional da Produção Mineral, Rio de Janeiro, I am very grateful for permission to study the important material of the collection of that institution.

To the American Museum of Natural History I am grateful for the solicitous assistance that I have received from its Department of Geology and Paleontology, from Mrs. Rachel Husband Nichols in the Osborn Library, from the staff of the Library, and from the Division of Photography during the preparation of this paper. The photographs reproduced as plates 32 to 37 and 40 to 43 were especially taken for this work by the Division of Photography.

Messrs. Carl Sorensen and Walter Sorensen, and William Fish, of the Laboratory of Vertebrate Paleontology of the American Museum are deserving of special acknowledgments for the careful preparation of, respectively, the material of *Carodnia vieirai*, new species, and of the complete mandible of *Trigonostylops apthomasi* here described.

To Dr. George Gaylord Simpson I am deeply indebted for valuable suggestions and constructive criticism during the preparation of this paper and for the loan of his unpublished manuscript on the Patagonian lower Eocene astrapotheres, which has given important information about the Casamayoran forms and the whole group in general. My opinion on the Patagonian species of *Trigonostylops* is based mostly on Simpson's direct observations on the type specimens in the Argentinean museums, but in part on my own direct observations on the same specimens. In an earlier paper (Price and Paula Couto, 1950) I selected *T. wortmani* as the best-defined species of this genus.

The following abbreviations are used to designate the locations of the specimens:

A.M.N.H., the American Museum of Natural History
D.G.M., Divisão de Geologia e Mineralogia do Departamento Nacional da Produção Mineral (formerly Serviço Geológico do Brasil), Brazil
M.A.C.N., Museo Argentino de Ciencias Naturales "Bernardino Rivadavia," Buenos Aires
M.N.R.J., Museu Nacional do Rio de Janeiro

SYSTEMATICS

THIS STUDY is concerned with the Condylarthra, Litopterna, Xenungulata, new order, and Astrapotheria.

The most surprising result of the study of the condylarths of São José de Itaborai was the revelation that the genus *Asmithwoodwardia* Ameghino is not a member of the Didolodontidae (the condylarth family restricted to South America) but a legitimate representative of the North American Hyopsodontidae in the South American Paleocene, a discovery made possible because the new material of this genus is the most complete yet found.

This fact is not really surprising, since the idea that the South American Cenozoic mammals arose, at least for the most part, from North American primitive groups that immigrated to South America during or immediately after Cretaceous times is generally accepted by most of the specialists, including the author. On the contrary, it is strong evidence in favor of this opinion.

Another important result of this work was the discovery that the genus *Carodnia* Simpson, first described from a single tooth from the Patagonian Paleocene, does not belong in any of the known mammalian orders. It is a very strange and aberrant form, here considered as the first known representative of a new order (Xenungulata).

The Order Astrapotheria is represented in São José de Itaborai by a species of the genus *Trigonostylops* Ameghino, a species which in its general characters appears to be more primitive than the species of Patagonia (Casamayor, lower Eocene). It also furnished almost certain evidence of the descent of this genus from the most primitive condylarthran stock in South America. This may also explain the slight resemblance between this group and the Litopterna.

ORDER **CONDYLARTHRA** COPE, 1881

FAMILY **DIDOLODONTIDAE** SCOTT, 1913

ERNESTOKOKENIA AMEGHINO, 1901

This genus was established by Ameghino for species based on remains collected in the lower Tertiary formations of Patagonia.

The species now known are from the upper Paleocene (Rio Chico) and lower Eocene (Casamayor) of that region. Two new species, closely related to their Patagonian congeneric species, are present in the Paleocene of São José de Itaborai.

The known Patagonian remains are merely isolated upper and lower molars. Among the specimens that were collected in São José de Itaborai are an almost complete left upper jaw, with P^{3-4} and M^{1-3} present, and a median fragment of a left lower jaw, with M_{1-3} present, as well as several upper and lower isolated premolars and molars.

These more complete remains enable me to add to the diagnosis of this genus, which was given by Simpson (1948, p. 110) on the basis of the material collected in Patagonia.

DIAGNOSIS: Upper molars wider than long; no mesostyle; accessory cusps poorly developed; continuous external cingulum, sometimes interrupted at the base of the paracone; large hypocone in M^{1-2}, not present in M^3. P^3 longer than wide, triangular, similar to P^{1-2} in *Didolodus*. P^4 as in *Didolodus*. Lower molars usually without cuspule on hypoconid-metaconid crest. Lower C strong, slightly procumbent, with sharp, pointed, and turned-up tip. P_1 small, compressed anteroposteriorly, and single-rooted. P_{2-3} simple, two-rooted. P_4 molariform, with high trigonid, low and short talonid, strong protoconid and metaconid, and small paraconid; low and more or less equally developed hypoconid and entoconid. Teeth generally of simple construction, with smooth enamel and bunoid cusps.

DISCUSSION: *Ernestokokenia* is very similar to *Didolodus*, but differs from it in P^{3-4}, which are very different in shape, in the complete absence of the mesostyle in its upper molars, and in the lack of a cuspule in the hypoconid-metaconid crest.

Ernestokokenia protocenica, new species

Plate 32, figures 1, 2

HOLOTYPE: M.N.R.J. No. 1430-V. Fragment of left maxilla with P^{3-4} and M^{1-3} present. Collected by Carlos de Paula Couto, 1948.

PARATYPE: M.N.R.J. No. 1431-V. Part of left lower jaw with M_{1-3} present. Same collector, 1948.

REFERRED SPECIMENS: M.N.R.J. No. 1432-V, small part of a right lower jaw with M_3; Nos. 1433-V, 1434-V, respectively left and right M_3; Nos. 1435-V, 1436-V, 1438-V, all right M_2; No. 1439-V, left M_2; Nos. 1440-V–1442-V, all right M_1; Nos. 1443-V, 1444-V, left M_1; No. 1445-V, right $P_{?4}$; Nos. 1446-V–1448-V, left $P_{?4}$; Nos. 1449-V, 1450-V, left $P_{?3}$; Nos. 1451-V, 1452-V, left M^3; Nos. 1453-V–1455-V, right M^2; No. 1456-V, left M^2; No. 1457-V, right M^1; Nos. 1458-V, 1459-V, left M^1; Nos. 1460-V, 1461-V, left P^3; No. 1462-V, right M^{2-3}. A.M.N.H. No. 49819, partial right lower jaw with M_{2-3}; No. 49820, left P^3; No. 49821, left $P_{?3}$; No. 49822, left $P_{?4}$; No. 49823, four M_1, unassociated; No. 49824, two left M^3 and one right M^3; No. 49825, two right M^2 and one left M^2; No. 49827, one left M_2 and one left M_3; No. 49829, three left M^1.

All these specimens were collected by Carlos de Paula Couto, 1948–1949.

DIAGNOSIS: Upper molars with the cingulum absent across protocone and hypocone and sometimes absent on the external side of the paracone. M^3 without hypocone, which is replaced by a wide cingulum. P^{3-4} without cingulum across protocone or on the external side of the paracone. Lower teeth as in diagnosis of the genus, but a more or less distinctly developed paraconid is present in the molars, as in *Didolodus;* a sharp anterior cingulum on M_{1-3}; another, short and more or less developed, across the hypoconulid on M_{1-2}. Large infraorbital foramen above and between P^{3-4}. Maxillo-maxillar suture large, extending from above the middle part of P^4 to the posterior end of M^3. An elongated foramen under and between P_4–M_1, equidistant from alveolar and lower borders of the external side of the lower jaw. Measurements are given in table 1.

DESCRIPTION: This species most resembles *E. chaishoer* Simpson, 1935, from the lower Eocene or upper Paleocene of Patagonia, in the structural conditions and proportions of its M^2, but it does not have the strong basal cuspule posterior to the metaconule, and the stronger one on the anterior cingulum, between the protocone and the paraconule, both of which are present on M^2 of *E. chaishoer*. Its lower molars are more distinctly different from those of *E. chaishoer*. They have no cuspule on the hypoconid-metaconid crest, and present a much smaller paraconid, compressed against the metaconid.

The paratype was not found in association with the holotype, but surely belongs in the same species. It came from a larger individual.

TABLE 1

MEASUREMENTS (IN MILLIMETERS) OF UPPER AND LOWER CHEEK TEETH OF *Ernestokokenia protocenica* (HOLOTYPE AND PARATYPE, RESPECTIVELY)

	Length	Width
P^3	6.2	5.7
P^4	6.2	7.8
M^1	6.6	8.1
M^2	8.3	9.8
M^3	7	8
M_1	6.7	5.3
M_2	8.1	6.9
M_3	11.2	7

Ernestokokenia parayirunhor, new species

Plate 32, figures 3–5

HOLOTYPE: M.N.R.J. No. 1468-V. Right lower jaw, almost complete, with alveoli of I_{1-2}, root of I_3, and with C, P_{3-4}, M_{1-3} present. Collected by Carlos de Paula Couto, 1948.

PARATYPES: D.G.M. No. 305-M, part of left upper jaw with M^{2-3} present; No. 249-M, posterior part of left lower jaw with M_{1-3} present. Both collected by Júlio da Silva Carvalho.

REFERRED SPECIMENS: D.G.M. No. 330-M, fragment of lower jaw, with the posterior part of the symphysis, and right C, P_{2-4}, M_{1-2}, and left C, P_2 present; No. 246-M, part of lower jaw, with the posterior part of the symphysis, and the right P_4, M_{1-3} present; No. 255-M, part of right lower jaw, with P_4, M_{1-3} present; No. 290-M, part of left lower jaw, with M_{2-3} present; No. 296-M, part of left lower jaw, with M_{2-3} present. M.N.R.J. No. 1469-V, anterior part of left lower jaw, with P_4–M_1 present; No. 1470-V, part of left lower jaw, with M_{1-2} present; No. 1466-V, part of left lower jaw, with M_{1-2} present; No. 1467-V, part of left lower jaw, with M_{2-3} present; No. 1861-V, part of left lower jaw, with M_2 present; No. 1862-V, left M_1,

very worn. A.M.N.H. No. 49815, portion of left lower jaw, with M_{1-2} present.

All the specimens designated with the abbreviation D.G.M. were collected by Júlio da Silva Carvalho, 1949, and those designated with the abbreviations M.N.R.J. and A.M.N.H. were collected by Carlos de Paula Couto, 1948.

DIAGNOSIS: Like *E. yirunhor* Simpson, but upper molars with continuous and wide external cingulum, and hypocone longitudinally aligned with the protocone. Measurements are given in table 2.

TABLE 2

MEASUREMENTS (IN MILLIMETERS) OF THE LOWER CHEEK TEETH OF *Ernestokokenia parayirunhor*, NEW SPECIES

	P_1		P_2		P_3		P_4		M_1		M_2		M_3	
	L	W	L	W	L	W	L	W	L	W	L	W	L	W
M.N.R.J. No. 1463-V	1.2[a]	1.9[a]	—	—	4.5	3	4.9	3.8	5	3.8	5.4	4.5	6.3	4.4
D.G.M. No. 330-M	1.3[a]	1.9[a]	3.2	2.6	4.3	3.2	5	3.6	4.9	3.8	5.5	4.7	—	—
D.G.M. No. 246-M	1.4[a]	2[a]	—	—	—	—	4.5	3.5	4.9	4	5.5	4.7	6.3	4.5
D.G.M. No. 255-M	—	—	—	—	—	—	4.5	3.4	5.1	4	5.6	4.8	6.2	4.3
D.G.M. No. 290-M	—	—	—	—	—	—	—	—	—	—	5.5	4.5	5.8	4.3
D.G.M. No. 296-M	—	—	—	—	—	—	—	—	—	—	5.7	4.8	6.3	4.5
M.N.R.J. No. 1464-V	—	—	—	—	—	—	5	3.8	5.2	4.4	—	—	—	—
M.N.R.J. No. 1465-V	1.2[a]	—	—	—	—	—	—	—	4.8	3.8	5	4.3	—	—
M.N.R.J. No. 1466-V	—	—	—	—	—	—	—	—	4.4	3.3	4.8	4	—	—
M.N.R.J. No. 1467-V	—	—	—	—	—	—	—	—	—	—	4.4	3.4	5	3.3

[a] Approximate.

DESCRIPTION: This species is distinguishable from *E. yirunhor* Simpson, from the Patagonian Paleocene (Rio Chican), only on the basis of its upper molars, as pointed out above. The lower molar pattern is the same in these two species, and the size, too, is more or less the same. Perhaps further discovery of more complete material, especially of *E. yirunhor*, might disclose additional and more important differences between these two species.

The type, M.N.R.J. No. 1468-V, and the paratype D.G.M. No. 249-M are the most complete specimens of *Ernestokokenia* ever found. In the type, the alveoli of I_{1-2} and P_{1-2}, the root of I_3, and the C, P_{3-4} and M_{1-3} are present, the formula thus being:

$$\frac{3.1.4.3}{}$$

P_1 is minute, with one root, compressed between the strong canine and the P_2. There is a mental foramen under the P_2, and another of about the same size under the M_1; a third foramen, smaller, is present under and between P_{2-3}. All these foramina are equidistant from the alveolar and lower borders of the mandible. The symphysis is narrow, but the tiny incisors are placed side by side in a transverse line. I_3 is located immediately in front of the C. The root of the C is procumbent, but its crown is directed upward. The posterior part of the paratype D.G.M. No. 249-M is almost complete. The coronoid process is high, the condyle is placed high above the level of the teeth, the angle is ample and round, and the posterior opening of the dental canal is large and slightly turned up, in the direction of the condyle, and placed more or less at the same level as the teeth. In general shape, the mandible does not differ from that of the North American Condylarthra, e.g., that of *Phenacodus*.

LAMEGOIA, NEW GENUS[1]

GENOTYPE: *Lamegoia conodonta*, new species.

DIAGNOSIS: Upper and lower molars strongly bunodont. Upper molars as in *Ernestokokenia*, but much larger, external cingulum weak or almost absent, no cingulum across protocone and hypocone. Lower molars

[1] In honor of Dr. Alberto Ribeiro Lamego.

with well-developed trigonid; paraconid as strong as metaconid; hypoconid crest directed to paraconid and presenting a small cuspule; entoconid small, sometimes preceded by a well-developed accessory cuspule; anterior cingulum strong; a short, but strong posterior cingulum between the hypoconulid and the hypoconid; several small cuspules in the valley between paraconid and hypoconid.

DISCUSSION: *Lamegoia* closely resembles *Ernestokokenia* in its upper molars, which are scarcely distinguishable from those of the latter genus, except in their much larger size. The lower molars are easily distinguished by the characters given above. The normal trigonid, with protoconid, paraconid, and metaconid, of nearly equal size and height, when unworn, the protoconid-hypoconid crest (instead of metaconid-hypoconid crest), and the relatively small and bifid entoconid, for example, are characters not found in any of the other known genera of the family.

Lamegoia conodonta, new species

Plate 32, figures 6–8

HOLOTYPE: M.N.R.J. No. 1463-V. Left $M_{?2}$. Collected by Carlos de Paula Couto, 1949.

PARATYPES: M.N.R.J. Nos. 1464-V and 1465-V, respectively left M^1 and right M^2. Same collector; 1949.

The paratypes were not found in association with the holotype but very probably belong to the same species, judging by their structure and large size.

DIAGNOSIS: Sole known species of the genus. Measurements (in millimeters): M_2, length, 11.9, width, 10.2; M^1, length, 11.5, width, 12; M^2, length, 11.1, width, 15.

DIDOLODONTIDAE IND.

M.N.R.J. No. 1842-V, an isolated left P^4, and M.N.R.J. No. 1841-V, an isolated right P_4, perhaps belong to a distinct unknown genus of this family. The P^4 agrees perfectly with Simpson's description of the homologous tooth of *Didolodus multicuspis* Ameghino, type species of *Didolodus*. There are no differences in form and structure between them, but the P^4 here considered is more than one and one-half times as large as the corresponding tooth of this largest species of *Didolodus*. The P_4 is also more than one and one-half times as large as the P_4 of *D. multicuspis*, but it is a little simpler, since its trigonid has no definite paraconid, and the small postero-mesial cusp of the talonid is isolated, instead of being connected by a crest with the middle part of the transverse ridge between the protoconid and the metaconid. Their measurements are (in millimeters): P^4, length, 11, width, 17.5; P_4, length, 10, width, 12.5. The much larger size of these more primitive specimens suggests the presence of an unknown genus of this family in the South American Paleocene, but these isolated premolars are insufficient evidence of this.

FAMILY **HYOPSODONTIDAE** LYDEKKER, 1889
SUBFAMILY **HYOPSODONTINAE**
TROUESSART, 1879

ASMITHWOODWARDIA AMEGHINO, 1901

The type of this until now monotypic genus is *A. subtrigona* Ameghino, 1901, based on one left upper molar, $M^{2\text{ or }3}$, and on one left lower molar, $M_{1\text{ or }2}$, from the Casamayor beds, Patagonia.

The specimens from São José de Itaborai, referred to this genus, show small differences in the structure of the upper molars and therefore may be considered as representative of a different species, which is described below.

Asmithwoodwardia scotti, new species[1]

Plate 33, figures 1–3; plate 34, figures 1–2

HOLOTYPE: D.G.M. No. 358-M. A badly crushed but nearly complete skull, with P^3, M^{1-3} and left P^{3-4}, M^{1-3}, accompanied by its nearly complete mandible with all the teeth present, the tip of an upper C, and the greater part of the axis. Collected by Júlio da Silva Carvalho, 1949.

PARATYPE: A.M.N.H. No. 49817. Fragment of right lower jaw with P_4, M_{1-2} present. Same collector, 1949.

DIAGNOSIS: Dental formula:

$$\frac{3(?).1.4.3}{3.\quad 1.4.3}$$

Upper and lower dentition without diastema. Upper molars with small but well-differenti-

[1] In memory of William Berryman Scott.

ated hypocone (absent on M^3), and strong but relatively narrow anterior and posterior cingula. Measurements are given in table 3.

TABLE 3

MEASUREMENTS (IN MILLIMETERS) OF UPPER AND LOWER MOLARS OF THE HOLOTYPE OF *Asmithwoodwardia scotti* (D.G.M. No. 358-M)

	Length	Width
M^1	3.7	4.5
M^2	3.5	5
M^3	2.9	4.7
M_1	3.8	2.9
M_2	3.8	3
M_3	4.3	2.7

DESCRIPTION: The upper molars of this species differ from the holotype $M^{2 \text{ or } 3}$ of *Asmithwoodwardia subtrigona* Ameghino, the type of the genus, only in the more distinct hypocone and relatively narrow anterior and posterior cingula. In *A. subtrigona*, the hypocone is a low cusp (Ameghino, 1901, p. 379), and the anterior and posterior cingula are much stronger and wider, especially the anterior one (Ameghino, 1906, fig. 80-A, p. 293). According to Ameghino's brief description, the lower molars of *A. subtrigona* have two opposite conical cusps (protoconid and metaconid) in the anterior lobe (trigonid), and four (?) cusps in the posterior lobe (talonid), one internal (entoconid), one external (hypoconid), both large, and two (?) median ones, placed in a longitudinal line (hypoconulid), with a deep basin surrounded by the four cusps of the talonid.

The presence of a cusp immediately anterior to the hypoconulid, not being a normal character, must be considered as an individual doubling of this last-mentioned cusp, not as a specific character of *A. subtrigona*. Ameghino (1906, fig. 80-A, p. 293) gave a figure of this lower molar with normal, not double, hypoconulid.

The lower molars of *A. scotti*, new species, do not differ from the $M_{1 \text{ or } 2}$ of the type of *A. subtrigona*. They are about the same as those of the type species in size.

Possibly future discovery of more complete material of *A. subtrigona* will permit us to establish a more definite distinction between the genotype and *A. scotti*, as would be expected from the time and space differences which separate these forms from each other (*A. subtrigona*, Casamayoran, lower Eocene, Patagonia; *A. scotti*, Paleocene, Itaborai, State of Rio de Janeiro, Brazil).

The skull and mandible of *A. scotti* are condylarthran in general shape and character. The skull is elongated and low; the orbits open widely into the temporal fossa; the postglenoid process is strong and conspicuous; the cranial cavity is narrow and low, as shown by its internal cast, preserved in matrix, which presents enormous olfactory lobes, small, flat, and smooth cerebral hemispheres, and apparently a very large cerebellum.

P^3 is as wide as long, subtriangular in outline, with a high antero-external main cusp, followed by a vestigial and confluent one (vestigial metacone?). There are a small meso-internal cusp (protocone?) and a broad, basined heel. A vestigial cingulum occupies the antero-internal and the external faces of the crown, and a strong one forms the posterior border of the broad heel. P^4 is wider than long, triangular in outline, and somewhat molariform, with strong protocone and paracone, vestigial metacone, confluent with the paracone, and small paraconule. The crown is surrounded by a cingulum, which is strong on the anterior and posterior faces, weak on the external face, and absent across the protocone. M^{1-3} are wider than long. M^{1-2} are similar in shape and in structure, but M^1 is a little longer and somewhat narrower than M^2. Protocone, paracone, and metacone are well developed and distinct, of nearly the same size and height, the protocone being a little smaller. The hypocone is small but distinct, not basal. Paraconule and metaconule are small and of nearly equal size. There are strong anterior and posterior cingula and a weak external cingulum. No cingulum is present across the protocone and the hypocone. M^3 is similar to M^{1-2}, but a little reduced, with small metacone and no hypocone.

The lower incisors are chisel-shaped and procumbent, arranged in an arch. The lower canine is large, sharp pointed, slightly procumbent, but with its tip turned upward. P_1

is minute, with one root and one cusp, and slightly procumbent. P_2 is larger than P_1, but smaller than P_3, and similar to the latter. It is a double-rooted and cutting tooth, compressed laterally, with a high antero-mesial cusp, followed by a small, broad heel, and by a basal postero-accessory cusp, which is connected to the main cusp by a rising crest. P_4 is somewhat molariform, longer than wide, with well-developed trigonid, strong and high protoconid, strong but smaller metaconid, a little posterior to the protoconid, and a rudimentary and anteriorly placed paraconid. The talonid is larger and deeper than in P_{2-3}, broader than long, with predominant hypoconid and small hypoconulid. M_{1-2} are structurally similar, with protoconid and metaconid of nearly equal size and height, and no distinguishable paraconid. The talonid is a little broader and longer than the trigonid, with predominant hypoconid, rather small but distinct entoconid, and smaller postero-median or sub-internal hypoconulid. A non-cuspidate and low ridge runs from the hypoconid to the metaconid. M_3 has nearly the same structure, but it is reduced in width and longer than the preceding molars, and its hypoconulid is larger and more prolonged posteriorly. P_4–M_3 present a more or less strong anterior cingulum. A weak and short posterior cingulum is present on P_4–M_2, running down from the base of the hypoconulid to that of the hypoconid.

Asmithwoodwardia is so similar to the North American Paleocene-Eocene Hyopsodontinae, in its general characters, and especially in the dental structure, that, in my opinion, the classification of this genus in this group is in complete accordance with its real affinities. The size of *A. scotti* is close to that of *Hyopsodus lepidus*, from the Bridger beds (lower Eocene) of the United States. If its remains were accidentally found in North America, they would probably be considered as representing a new species of this small North American lower Eocene relative. Thus I believe that the differences between *Asmithwoodwardia* and the Paleocene-Eocene North American forms classified in the subfamily Hyopsodontinae are merely of generic rank, and therefore that this Paleocene-Eocene South American genus may be, or, better, must be classified among the Hyopsodontinae, as is done here. It is the first known representative of this subfamily in South America.

In spite of the great similarities between *Ernestokokenia* and *Asmithwoodwardia*, it seems to me that the former, on the basis of the more complete knowledge we now have, is more closely allied with the most primitive Phenacodontidae, e.g., *Tetraclaenodon* Scott, from the middle Paleocene of North America, than with the Hyopsodontidae. Moreover, its species are much larger than those of *Asmithwoodwardia*, and than those of all the other known Hyopsodontidae, but agree well in size with the most primitive Phenacodontidae.

Didolodus Ameghino, from the lower Eocene (Casamayoran) of Patagonia, also has close similarities to the Phenacodontidae, as has already been pointed out by Simpson (1948, p. 96), who says that the resemblance in the dentition, in *Didolodus* and *Phenacodus*, is "so close that were the genus [*Didolodus*] found in North America it would be referred to the Phenacodontidae with little question. The outstanding difference from North American genera is in P^{3-4}_{3-4}, these teeth, of upper and lower jaws, respectively, being of almost the same size and structure in *Didolodus*, instead of having P^4_4 definitely more complex than P^3_3, and at least P^4 is somewhat less molariform than in the true phenacodonts."

In this particular, *Ernestokokenia* more closely resembles the Phenacodontidae, since, as already shown, its P^3_3 are definitely much more simple than P^4_4, which are somewhat molariform, as are the P^{3-4}_{3-4} of *Didolodus*, though less produced transversely than these, and triangular instead of roughly quadrangular in outline. But, like *Didolodus*, *Ernestokokenia* is clearly as specialized as *Phenacodus*, although in a different way, and belongs surely to a different phylogenetic line, very close to that of *Didolodus*.

Consequently, I believe that *Ernestokokenia* must be retained in the family Didolodontidae, with *Didolodus*, *Paulogervaisia*, *Proectocyon*, *Enneoconus*, and the other South American known condylarths, while *Asmithwoodwardia*, now the best-known South American condylarth, is here dissociated

from this family and considered a representative of the Hyopsodontidae in the South American continent.

ORDER **LITOPTERNA** AMEGHINO, 1889

FAMILY **MACRAUCHENIIDAE** GILL, 1872

VICTORLEMONINEA AMEGHINO, 1901

One of the two species of litopterns known from the Itaboraian fauna is referable to this genus, which is represented in the Casamayoran fauna (lower Eocene) of Patagonia by three species (Simpson, 1948, pp. 119–121).

It seems to me that the Itaboraian species is a little more primitive than the Casamayoran species in the structure of its molars, especially the upper molars, whose cusps, though markedly selenolophodont, are slightly bunoid.

Victorlemoinea prototypica, new species

Plate 34, figures 6–8

HOLOTYPE: M.N.R.J. No. 1470-V. Right $M^{2 \text{ or } 3}$. Collected by Carlos de Paula Couto, 1948.

PARATYPE: M.N.R.J. No. 1471-V. Left M^3. Same collector, 1948.

REFERRED SPECIMENS: M.N.R.J. Nos. 1472-V–1474-V, three left upper molars; Nos. 1475-V–1478-V, four right upper molars; No. 1480-V, fragment of left lower jaw with P_4 present; No. 1481-V, right $P_{?3}$; Nos. 1482-V–1486-V, right lower molars; Nos. 1487-V, 1488-V, left $P_{?3}$; Nos. 1489-V, 1490-V, 1492-V, left lower molars. D.G.M. No. 268-M, fragment of left lower jaw with $P_{3-4(?)}$, and $M_{?1}$ present.

The specimens designated with the abbreviation M.N.R.J. were collected by Carlos de Paula Couto, 1948, and the single specimen designated with the abbreviation D.G.M. was collected by Júlio da Silva Carvalho, 1949.

These specimens are referred to this species with some doubt.

DIAGNOSIS: Large species. Upper molars with slightly bunoid cusps. Anterior cingulum terminating in a strong and more or less prominent transverse ridge (protostyle) lateral to the base of the protoconule. A narrow cingulum, sometimes absent, across the protocone and hypocone. Measurements (in millimeters): M.N.R.J. No. 1470-V, type $M^{2 \text{ or } 3}$, length, 14.2, width, 16.5.

FAMILY **PROTEROTHERIIDAE** AMEGHINO, 1887

ANISOLAMBDA AMEGHINO, 1901

Anisolambda AMEGHINO, 1901, p. 383. SIMPSON, 1948, p. 130.

Anissolambda AMEGHINO, 1906, p. 467.

Josepholeidya AMEGHINO, 1901, p. 384; 1904a, vol. 57, p. 340; 1904b, p. 124; 1906, p. 467. SCHLOSSER, 1923, p. 525. SIMPSON, 1935, p. 10, fig. 10; 1948, p. 125.

Eulambda AMEGHINO, 1904a, vol. 57, p. 340; 1906, p. 467. SIMPSON, 1948, p. 125 (as a synonym of *Josepholeidya* Ameghino, 1901).

GENOTYPE: *Anisolambda fissidens* Ameghino.

GENOTYPE OF *Josepholeidya: Josepholeidya adunca* Ameghino (=*Anisolambda fissidens* Ameghino?).

This genus was established on lower molars from the Casamayor beds (lower Eocene) of Patagonia, among which two different species (*A. fissidens* Ameghino, 1901, type, and *A. deculca* Simpson, 1948) are recognized (Simpson, 1948, pp. 130–131).

The discovery of upper teeth, in São José de Itaborai, in association with lower ones which are referable to this genus, allow me to know its upper dentition for the first time, and, what it is more important, to confirm Simpson's opinion (1948, p. 130) about the relations between this genus and *Josepholeidya* Ameghino, 1901, based on upper teeth from the same Patagonian horizon.

Simpson states that the lower teeth of *Anisolambda* probably belong to the group of *Josepholeidya*, *Ricardolydekkeria*, and *Guilielmofloweria*, and, therefore, that *Anisolambda* may be synonymous with one or more of these three genera.

I am able to say now that *Anisolambda* is indeed indistinguishable from *Josepholeidya*, or vice versa, and, therefore, that these two generic names are perfect synonyms. Both of them were proposed by Ameghino at once, in the same paper (1901, p. 383, *Anisolambda*, and p. 384, *Josepholeidya*). In these conditions, either of these names may be selected to designate the genus. I prefer *Anisolambda* because it seems to me a more euphonious name.

This genus is represented in the Itaboraian fauna (Paleocene) by a species, which is described below, a little more primitive than the Casamayoran species.

Anisolambda prodromus, new species

Plate 34, figures 4–5; plate 35, figures 1–6

HOLOTYPE: D.G.M. No. 262-M. Right lower jaw of a very young individual, with apex of DI_3 in the alveolus, root of C, and with P_2, DM_{3-4}, and M_1 present. Collector: Júlio da Silva Carvalho, 1949.

PARATYPES: D.G.M. No. 304-M, part of a right upper jaw with DM^{3-4} and M^1 present; No. 239-M, partial left lower jaw with P_2, DM_{3-4}, and M_1 present, perhaps the opposite side of the holotype; No. 273-M, fragment of right and left upper jaw with right and left P^2, and DM^{3-4}, and left M^1 present, the last still inside the alveolus.

All these specimens were collected by Júlio da Silva Carvalho, 1949.

REFERRED SPECIMENS: M.N.R.J. No. 1479-V, left $M^{?2}$; Nos. 1493-V, 1494-V, right $M_{?2}$; Nos. 1495-V, 1496-V, left $M_{?2}$; No. 1858-V, fragment of left lower jaw with DM_{3-4} and M_1 present; No. 1859-V, left M_3. D.G.M. No. 238-M, fragment of right lower jaw with M_{1-2} present; No. 307-M, partial left upper jaw with P^2, DM^{3-4}, M^1 present; No. 310-M, fragment of right upper jaw with M^{2-3}, and incomplete posterior part of the skull.

The specimens preceded by the abbreviation M.N.R.J. were collected by Carlos de Paula Couto, 1948, and those preceded by the abbreviation D.G.M. were collected by Júlio da Silva Carvalho, 1949.

The teeth of paratype D.G.M. No. 304-M occlude perfectly with the corresponding teeth of the type. They are equally worn, and in these circumstances it is possible that these two specimens belong to the same individual.

DIAGNOSIS: Upper molars with crown of moderate height. Hypocone distinct from protocone. Internal accessory cuspule absent. Broad posterior cingulum. A well-developed accessory conical cuspule is present on the posterior cingulum of M^3 at the internal end of the hypocone, and well separated from this last cusp; it is absent on M^2. A more or less distinct external cingulum runs across the base of the ectoloph. Lower molars very similar to those of *A. fissidens* and *A. amel*, but with paraconid placed a little more posteriorly and preceded by a broad accessory cingulum, which runs down from the anterior end of the antero-external crescent (protoconid) to the antero-internal side of the tooth. Anterior and posterior cingula present. No external cingulum. Very small cuspule on metaconid-hypoconid crest, at least on M_3. Measurements are given in table 4.

DESCRIPTION: The isolated molars referred to this species show that it was larger than *A. amel* Simpson, and more or less of the same size as the genotype, *A. fissidens* Ameghino, or a little smaller than the latter. The isolated M_3 (M.N.R.J. No. 1839-V) displays a very small accessory cuspule on the metaconid-hypoconid crest, as in the condylarths, which is well distinguishable only on slightly worn teeth.

The DI_3 (fragment of the apex inside the alveolus) was somewhat canine-like, compressed laterally, suboval in cross section, but with slightly sharp-edged anterior and posterior borders. The lower canine (root) was well developed, compressed transversely, and suboval in cross section. An antero-posteriorly elongated foramen is seen under the canine, and another much smaller one is present under and immediately in front of P_2.

P_2 is a small and, to some degree, a cutting tooth, with much compressed trigonid, high protoconid, and a slightly smaller metaconid, connected with the protoconid by a crest which runs obliquely. Another sharp crest runs down from the protoconid to the middle of the anterior border of the trigonid, with a strong depression on its inner side. The talonid is low, broader than long, with strong external declivity, and a small postero-median cusp (hypoconulid), from which a weak and depressed crest runs up to the metaconid. The next tooth, DM_3, is somewhat molariform, with complete trigonid and talonid, the former slightly higher and narrower than the latter. The metaconid is higher than the other cusps, the paraconid being the lowest of them and placed at the antero-internal angle of the tooth, as in the molars of the typical macraucheniids. The

talonid is much broader than long, with well-developed hypoconid, entoconid, and hypoconulid. The last milk tooth, DM_4, is perfectly molariform; its trigonid is broader than long, with the trigonid basin closed at inner side by the high paraconid, which has almost the same height as the metaconid, the protoconid being the lowest of the trigonid cusps. The talonid is as broad as the trigonid but much longer, with large conical entoconid, which attains nearly the same size as the hypoconid. The hypoconulid is a little smaller and placed near the hypoconid, from which it is separated by a short notch. Weak anterior and posterior cingula are present in DM_{2-4}.

P^2 is perfectly triangular in outline and slightly wider than long, with a low crescentic internal cusp (protocone-hypocone) and a high, transversely compressed, and meso-external one (paracone-metacone), from which one crest runs forward to the distinct parastyle and another runs back to the strong metastyle. No mesostyle is present. There are narrow anterior and posterior cingula. The next tooth, DM^3, is somewhat molariform, roughly triangular, with low, distinct, but coalescent protocone and hypocone, both distinctly separated from the protocone and with their bases slightly separated in the central valley, large, distinct paracone and metacone, strong parastyle, mesostyle, and metastyle, the last one less prominent than the first two. The anterior and posterior cingula are broad and crenulated, and the external cingulum is weak. There is no internal cingulum. M^1 is closely similar to DM^4, but about 80 per cent larger. M^{2-3} are also closely similar, but M^2 is larger than M^1 and smaller than M^3. This last differs from the anterior molars by the presence of a small but distinct, conical accessory cuspule on the posterior cingulum, immediately internal to the hypocone.

The posterior fragment of skull in general cone, small and conical paraconule and metaconule, large, very distinct paracone and metacone, nearly equal in size, very strong parastyle and mesostyle, small metastyle, broad anterior and posterior cingula, and a slight external cingulum. The last upper milk tooth, DM^4, is much larger than the anterior teeth, perfectly molariform, much broader than long, with well-defined protocone and hypocone, with their bases in contact, well-developed paraconule and meta-

TABLE 4

MEASUREMENTS (IN MILLIMETERS) OF THE CHEEK TEETH OF *Anisolambda prodromus*, NEW SPECIES

	P_3		DM_2		DM_4		M_1		M_2		DM^3		DM^4		M^1		M^2		M^3	
	L	W	L	W	L	W	L	W	L	W	L	W	L	W	L	W	L	W	L	W
Holotype, D.G.M. No. 262-M	4.8	2.2	5.9	3.3	6.3	4	7.8	4.9	—	—	—	—	—	—	—	—	—	—	—	—
Paratype, D.G.M. No. 239-M	5	2.7	5.9	3.3	6.4	4	8	5	—	—	—	—	—	—	—	—	—	—	—	—
Paratype, D.G.M. No. 304-M	—	—	—	—	—	—	—	—	—	—	5.5	6.1	6.4	7.9	8.1	9.6	—	—	—	—
M.N.J.R. No. 1479-V	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	11.9	14.6	—	—
M.N.J.R. No. 1493-V	—	—	—	—	—	—	—	—	9.4	6	—	—	—	—	—	—	—	—	—	—
M.N.J.R. No. 1495-V	—	—	—	—	—	—	—	—	9.5	6	—	—	—	—	—	—	—	—	—	—
D.G.M. No. 310-M	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9.5	12.2	10.8	13.5

resembles the corresponding part of the skull of the other genera of the same group, for example, that of the lower Miocene (Santa Cruz) proterotheriid *Thoatherium*. The sagittal crest is very high and prominent, but relatively short. The temporal foramina are numerous and well marked. The orbits are only partially enclosed by bone posteriorly. The postorbital processes are relatively short, strong, broad, more or less rounded and conical, anteriorly concave and posteriorly convex, and not perforated by supraorbital foramina. There is a large open space between them and the jugals. The frontals are very large and broad, smooth, transversely convex, and provided with large frontal sinuses. A very small vascular foramen, directed forward, is present on each side of the sagittal suture and more or less in the same transverse line with the mesial part of the orbits. The optic and lacerum anterius foramina are, it seems, fused, to form a large but laterally compressed single foramen. The foramen rotundum is large, placed below and a little ahead of the optical foramen. A very well developed foramen ovale is situated behind and a little below the foramen rotundum. There are no discernible signs of an alisphenoid canal, which is probably confluent with the foramen ovale.

The fact that the orbits are not completely closed by bone posteriorly seems to me not to be a valid objection against the classification of this form among the Proterotheriidae, although the orbits are closed posteriorly in all the other members of this family of which the skull is known, ranging from the lower Oligocene to the Pliocene of Argentina. As the open orbit is a primitive feature, it is perfectly admissible that it could be the normal condition in the most primitive members of this group, such as *Anisolambda*. It is true that Simpson (1948, p. 123), certainly the greatest authority in this field today, places this genus and its correlatives, all from the lower Eocene (Casamayoran) of Patagonia, only tentatively within the Proterotheriidae.

As the available material is again insufficient to settle this doubt, further discussion of this point would be futile. Only future discoveries of more numerous and better specimens, including associated foot bones, can resolve this doubt.

XENUNGULATA,[1] NEW ORDER

DIAGNOSIS: Extinct, large, digitigrade South American primitive ungulates with relatively short and somewhat slender limbs, pentadactyl extremities, broad and flat ungual phalanges. Carpal bones alternating. Mandible strong, high, but relatively slender and short. Dentition complete. Incisors strong, chisel-shaped. Canines strong and sharp pointed. Cheek teeth brachyodont. Upper and lower first and second premolars simple, compressed laterally, with a main mesial cusp. Upper third and fourth premolars with V-shaped protocone and strong meso-external paracone. Upper molars bilophodont, but the third one with protoloph and metaloph converging inwardly, and low, basal hypocone. Last lower premolar somewhat molariform, with low and short talonid, slightly crested. First and second lower molars bilophodont; third molar with strong protolophid and more or less isolated hypoconid and entoconid, followed by strong hypoconulid.

CARODNIIDAE, NEW FAMILY

DIAGNOSIS: The same as that of the order.

CARODNIA SIMPSON, 1935

Carodnia SIMPSON, 1935, p. 20.
Ctalecarodnia SIMPSON, 1935, p. 22.

GENOTYPE: *Carodnia feruglioi* Simpson, 1935.

GENOTYPE OF *Ctalecarodnia*: *Ctalecarodnia cabrerai* Simpson, 1935.

DISTRIBUTION: Paleocene (Itaboraian) of Brazil and Paleocene (Rio Chican) of Patagonia.

DIAGNOSIS: Dental formula:

$$\frac{3(?).1.4.3}{3.\ 1.4.3}$$

Small diastema between the upper C and P^1. Lower teeth in continuous series. Incisors strong, procumbent, compressed laterally. Canines strong, but simple, gently curved, and sharp pointed. P_{1-2}^{1-2} two-rooted, compressed laterally, much longer than wide, with a main and strong mesial cusp, P_2^2 much larger than P_1^1. P^{3-4} three-rooted, transverse,

[1] A name suggested by my colleague Dr. Paulo Emílio Vanzolini.

equal, with strong conical protocone and high meso-external paracone, confluent with metacone. P_3 similar to P_2 but with an incipient protolophid and a little wider talonid. P_4 somewhat molariform, quadrangular, trigonid quadrate, with a well-developed protolophid, wide talonid with small conical hypoconid and low metalophid. M_1^1 bilophodont; protoloph and protolophid larger than metaloph and metalophid, respectively, the protoloph and metaloph somewhat convex anteriorly, and the protolophid and metalophid somewhat concave anteriorly, all slightly oblique transversely and rising to a cusp at each end. An open transverse valley separates the crests. M^1 wider than long, with strong anterior cingulum and a weak posterior one. M_1 longer than wide, with wide anterior and strong posterior cingula. M_2^2 similar to but larger than M_1^1. M^3 resembling that in the Dinocerata, larger than M^2, and much wider than long; protoloph larger than metaloph, somewhat convex anteriorly, running externally to a high conical paracone and internally confluent with the metaloph at the tip of the strong, crescentic protocone, the two crests forming a rough V-shaped figure. Metaloph slightly curved in an S and externally limited by a strong conical metacone, which is lower than the paracone. Strong anterior cingulum and a much stronger and wider, but shorter, posterior one, the latter running from the base of the metacone up to the tip of the well-developed, crescentic hypocone, which is much lower than the protocone; a short and weak postero-internal cingulum from the base of the hypocone to the postero-internal corner of the base of the protocone. No cingulum on the external face and across the protocone. M_{1-3} without distinct paraconids. Talonid slightly lower and narrower than trigonid, simple, without closed basin, and followed by strong posterior cingulum. M_{2-3} much larger than the anterior cheek teeth. M_3 resembling that in the Dinocerata and Pantodonta, with trigonid bearing a very strong protolophid, somewhat concave anteriorly, rising to a cusp at each end. Talonid a little longer than the trigonid, but not prolonged into a third lobe. Hypoconid separate, nearly conical. Hypoconulid nearly as high as the metaconid, but smaller, and almost completely isolated or connected with the entoconid by a high, sharp, crenulated crest, somewhat concave anteriorly. Entoconid crescentic, more or less distinct, lower than the other cusps of the talonid. Mandible strong, high, but relatively slender and short, with broad angular region, high but short coronoid process, perpendicular to the alveolar border, and broad condyle, much wider than long, situated high above the level of the teeth; lower border convex inferiorly; symphysis extended back to a point above the posterior end of P_3, completely ossified in the adults, and deeply fluted above. Cervical vertebrae short. Bones of the extremities moderately elongated and relatively slender. Fore and probably hind foot pentadactyl.

Carodnia feruglioi Simpson, 1935

Carodnia feruglioi SIMPSON, 1935, p. 22.

HOLOTYPE: In Feruglio Collection, University of Padua, Italy. Cast A.M.N.H. No. 27886. Left M_3.

REFERRED SPECIMENS: In Feruglio Collection, University of Padua, Italy, partial talonid of a right M_1 (cast A.M.N.H. No. 27887), and a partial right $I_{?3}$ (cast A.M.N.H. No. 27894).

HORIZON AND LOCALITY: Lower Rio Chico formation (upper Paleocene), Bajo de la Palangana, Argentina.

DIAGNOSIS: M_3 with crenulated crest curving from protoconid around the antero-external border and ending at midline. Hypoconid prolonged transversely to join a low, vague, longitudinal crest slightly external to the midline. This vague crest ends posteriorly in the hypoconulid. Entoconid represented by a slightly more prominent eminence near the anterior end of the crest which connects it with the hypoconulid. Posterior cingulum of M_1, and probably of M_2, median.

Carodnia cabrerai (Simpson, 1935)

Ctalecarodnia cabrerai SIMPSON, 1935, pp. 23–24.

HOLOTYPE: In Feruglio Collection, University of Padua, Italy, left P_4, almost complete, talonid of left M_1, and talonid and posterior part of trigonid of right M_1. Casts A.M.N.H. No. 27897.

HORIZON AND LOCALITY: The same as for *C. feruglioi*.

DIAGNOSIS: Lower molars with a median posterior cingulum, about half as wide as the main crests, which forms a much smaller basal crest. Probable P_4 with talonid crest relatively smaller than that of the molars but quite prominent and horizontal.

DISCUSSION: At the time *Ctalecarodnia* was described, direct comparison with *Carodnia* was impossible, because the latter was known only by its left M_3 (type), while the M_3 of *Ctalecarodnia* was unknown, and it also was difficult to guess that *Carodnia* could have M_1 or M_2 similar to those attributed to *Ctalecarodnia*. But I can now say that the anterior lower molars and premolars of *Ctalecarodnia* are indistinguishable from those of *Carodnia*, and therefore that these two generic names are synomyms. Both of them were proposed by Simpson, in the same paper (1935, p. 20, *Carodnia;* p. 22, *Ctalecarodnia*). In these circumstances, either of them may be selected to designate the genus. I believe that *Carodnia* is preferable because it is simpler and more euphonious.

It is also possible that *Carodnia cabrerai* is synonymous with *C. feruglioi*, in spite of the great difference in size between the lower premolars and the lower anterior molars of the former, and the lower M_3 of the latter, since, as we have seen, the two last upper and lower molars of *Carodnia* are much larger than the anterior cheek teeth. However, the difference in size between the type lower teeth of *C. cabrerai* and the type M_3 of *C. feruglioi* is so great that it is possible that they belong in two different species, as I have left them, or at least that the specimens are from two or more individuals of a single species (*C. feruglioi*), but of different ages.

Carodnia vieirai, new species[1]

Plate 36; plate 37, figures 1, 2; text figure 2

HOLOTYPE: D.G.M. No. 333-M. Fragments of right and left maxillae, with right P^{1-4} and partial M^{2-3}, left C (root), P^{1-4}, partial M^{1-2}, and M^3 present. Isolated two upper I. Isolated root of right upper C. Fragment of the occiput with the condyles. Nearly complete mandible with right I_1 alveolus of C, roots of P_{1-3}, fragmentary P_4–M_1, and complete M_{2-3}, and left I_{1-3}, alveolus of C, and P_1–M_3 present. Isolated right and left lower C. All the cervical and the first two dorsal vertebrae. Fragmentary first left rib. Proximal fragment of left scapula. Part of the bones of the anterior and posterior extremities, and other fragmentary skeletal remains. Collected by Júlio da Silva Carvalho, 1949. Cast A.M.N.H. No. 49849.

REFERRED SPECIMENS: D.G.M. No. 334-M, mandible of an immature individual with complete dentition (cast A.M.N.H. No. 49848); No. 335-M, fragment of right maxilla with C and with $I^{?3}$ cemented against the C (cast A.M.N.H. No. 49848), fragment of the anterior part of the skull of another individual with right P^{1-2} and left P^{1-3} present, posterior fragment of left maxilla with P^4–M^2 (cast A.M.N.H. No. 49853), and isolated left P^{3-4}, M^1, M^2, and right M^3; Nos. 336-M, 337-M, various skeletal remains (cast A.M.N.H. No. 49850, right forearm and hand). A.M.N.H. No. 49828, left M^3. M.N.R.J. No. 1843-V, right P^1; No. 1844-V, left P^2; No. 1845-V, right P^2; No. 1848-V, right M_1; No. 1849-V, right I_1; No. 1850-V, right P_1; No. 1852-V, right M_1; No. 1853-V, right M_3; No. 1846-V, left P^3; No. 1847-V, right M^3; No. 1851-V, right P_2; No. 1854-V, left M_3; No. 1855-V, posterior fragment of left M^2; No. 1856-V, talonid of right M_3; No. 1857-V, talonid of milk cheek tooth.

The specimens preceded by the abbreviations D.G.M. and A.M.N.H. and M.N.R.J. Nos. 1846-V, 1847-V, and 1851-V were collected by Júlio da Silva Carvalho, 1949. M.N.R.J. No. 1854-V was collected by José Vieira da Silva, 1948. All the other specimens were collected by Carlos da Paula Couto, 1948.

DIAGNOSIS: P_4 with talonid crest nearly as wide as the protolophid but very low, running down from the hypoconid to the postero-internal corner of the tooth and relatively much smaller than that of the molars. In M_3, the crest curving from protoconid around the antero-external border and ending at midline vestigial or weak, and not crenulated. Hypoconid strong and conical, sometimes a little prolonged transversely, separated from

[1] In honor of José Vieira da Silva, overseer in the quarry of the Companhia Nacional de Cimento Portland (Mauá), in São José de Itaborai, the first discoverer and collector of remains of this species and careful guardian of the fossils of the locality.

the hypoconulid by a deep notch. Entoconid quite pronounced, more or less crescentic, and connected with the hypoconulid by a sharp and crenulated crest or sometimes separated from it by a notch. Posterior cingulum of M_{1-2} running from the midline to the postero-external corner of the tooth.

Description

Skull and Upper Dentition: The holotype right and left maxillae (D.G.M. No. 333-M) are very incomplete. They are reduced to their lower portion, including the teeth, part of the palatal extension, and part of the palatines. The left side also has a part of the zygomatic process. The base of the zygoma is nearly vertical and situated above M^2; its upper part is lacking. The palate is strongly vaulted, mostly in the part anterior to P^3, from which it descends abruptly backward to M^1, to reach a horizontal level. There are no discernible sutures.

The occipital condyles are large, almost meeting at the midline on the base of the smooth occipital crest. They are bounded by a well-marked groove, which is lacking only on the internal side. They present two convex articular surfaces, one superior, the other inferior, limited by a very smooth ridge, and project well backward, forming an angle of about 40 degrees with the occipital.

An upper incisor is present in the specimens (D.G.M. No. 335-M, $I^{?3}$); it is out of place, cemented against the internal face of the upper canine. It is strong, chisel-like, with the crown completely covered by enamel. Its anterior face is convex, and the posterior slightly concave; a strong U-shaped cingulum occupies the base of the posterior face, rising to the top of the crown, on the postero-external border, and attaining the internal side of the anterior face on the opposite border. This incisor is exactly similar, except in size, to that found with the holotype of *Carodnia feruglioi* (Feruglio Collection, cast A.M.N.H. No. 27894; Simpson, 1935, p. 24, fig. 23), which leads me to believe that the latter belongs to a young individual of *C. feruglioi* (it is one-half smaller than the incisor of our specimens).

The upper canine of the same specimen (D.G.M. No. 335-M) was not completely erupted. It is a large and sharp-pointed tooth, gently convex anteriorly and transversely oval, with its crown completely covered by a thin and finely grooved coat of enamel. The root of an isolated right upper canine, attributed to the holotype (D.G.M. No. 333-M), is present in our collection. It is enormous, convex anteriorly, closed at its posterior end, very thick in its middle part, and progressively thinner towards its upper part and towards the crown.

The left upper canine is represented only by a part of the root, which is in the holotype relatively little developed, slightly larger than the root of P^1, and ellipsoidal in transverse section.

P^1 is small, its tip being more or less at the same level as the base of the crown of the following teeth. It is a single-rooted tooth, much larger than wide, with a conical, mesial main cusp, surrounded on the internal side by a low and smooth expansion of the base of the crown and presenting a very weak anterior and posterior ridge, which runs from its tip to the middle part of its anterior and posterior borders, respectively.

P^2 is enormous, much longer than wide, double-rooted, with the anterior root implanted obliquely forward; it has a strong mesial, conical main cusp, anteriorly concave, followed by a papillated crest, which runs down from its tip to the mesial part of the posterior border of the tooth. A more or less definite cingulum surrounds the crown except on the middle part of its external face; it is very strong, and expanded laterally on the posterior corners of the tooth.

P^{3-4} are triangular in outline, wider than long, with mesial, V-shaped protocone, strong, conical, meso-external paracone (with completely confluent metacone almost indistinguishable). The paracone is the highest cusp. There are a strong parastyle and a vestigial mesostyle, each of these two cuspules being connected with the protocone by a sharp crest (protoloph and metaloph, respectively), which encloses a small trigonal basin. These teeth have wide anterior, posterior, and external cingula, the latter interrupted on the middle part of the external face. P^4 is a little wider, but slightly shorter, than P^3.

M^{1-2} are more or less quadrangular, wider than long, with two transverse, parallel,

TABLE 5

MEASUREMENTS (IN MILLIMETERS) OF THE OCCIPITAL REGION AND MANDIBLE OF THE HOLOTYPE OF *Carodnia vieirai*, NEW SPECIES (D.G.M. No. 333-M)

(Measurements of a referred specimen, D.G.M. No. 334-M, are in parentheses.)

Occipital region	
Width between most external points of occipital condyles	118
Height of foramen magnum	28.5[a]
Width of foramen magnum	39.5[a]
Mandible	
Length from anterior border of symphysis to posterior border of angular region	392.5 (394)
Length from anterior border of symphysis to middle part of posterior border of condyle	393.5 (355.5)
Height of posterior part, from upper border of coronoid process to lower border of mandible, on line passing by anterior border of posterior opening of dental canal	218.3
Height, below middle part of M_1	97.2 (73.9)
Thickness, under M_1	32 (35.5)

[a] Approximate.

non-crenulated ridges (protoloph and metaloph), concave anteriorly and on the top, rising to a cusp at each end. These two ridges are separated by a deep transverse valley, open at both ends, the posterior one being wider than the anterior. The anterior and posterior cingula are wide, the anterior running down from the tip of the antero-internal cusp (protocone), and the posterior running from the base of the postero-internal cusp (hypocone) to the base of the postero-external one (metacone). There is an external cingulum on the base of the antero-external cusp, but no cingulum across the internal face. M^2 is much larger in all dimensions than M^1.

M^3 is less quadrangular than the preceding molars, wider than long, with the two transverse ridges converging inwardly and meeting on the tip of the protocone. The anterior ridge is convex anteriorly, with a wide concave posterior declivity and concave paracone. The posterior ridge is less wide than the anterior and sinuous, that is, anteriorly convex on its external part and anteriorly concave on its internal half, rising to the protocone and to the metacone; it is sometimes crenulated. The protocone is strong, V-shaped. The paracone and the metacone are approximately conical, the former being the highest cusp of the trigon and the latter the lowest, and separated from the paracone by a very deep notch, by means of which the large trigonal basin communicates with the external face. There are wide anterior and posterior cingula, the latter rising internally to a strong, basal hypocone, immediately posterior to the protocone, from which it is separated by a notch. External and internal cingula weak or absent. The M^3 of *Carodnia* is so similar to that of *Uintatherium* Leidy, 1872, a member of the Dinocerata from the middle Eocene of North America, that if it were found accidentally in North America, it could easily be considered as belonging to the Dinocerata and closely related to *Uintatherium*. The only difference between the M^3 of these two genera is the fact that in *Carodnia* the hypoconid constitutes an elevation of the internal end of the wide posterior cingulum, being separated from the protocone by a notch, while in *Uintatherium* the hypocone is surrounded by the posterior cingulum and is placed against the protocone. This similarity between the M^3 of *Carodnia* and *Uintatherium* is perhaps accidental, since the anterior molars and the premolars are very different in shape and structure in these two genera. But it is also possible that this is an indication of close relationship between these two genera, which might have been derived from a common ancestral stock.

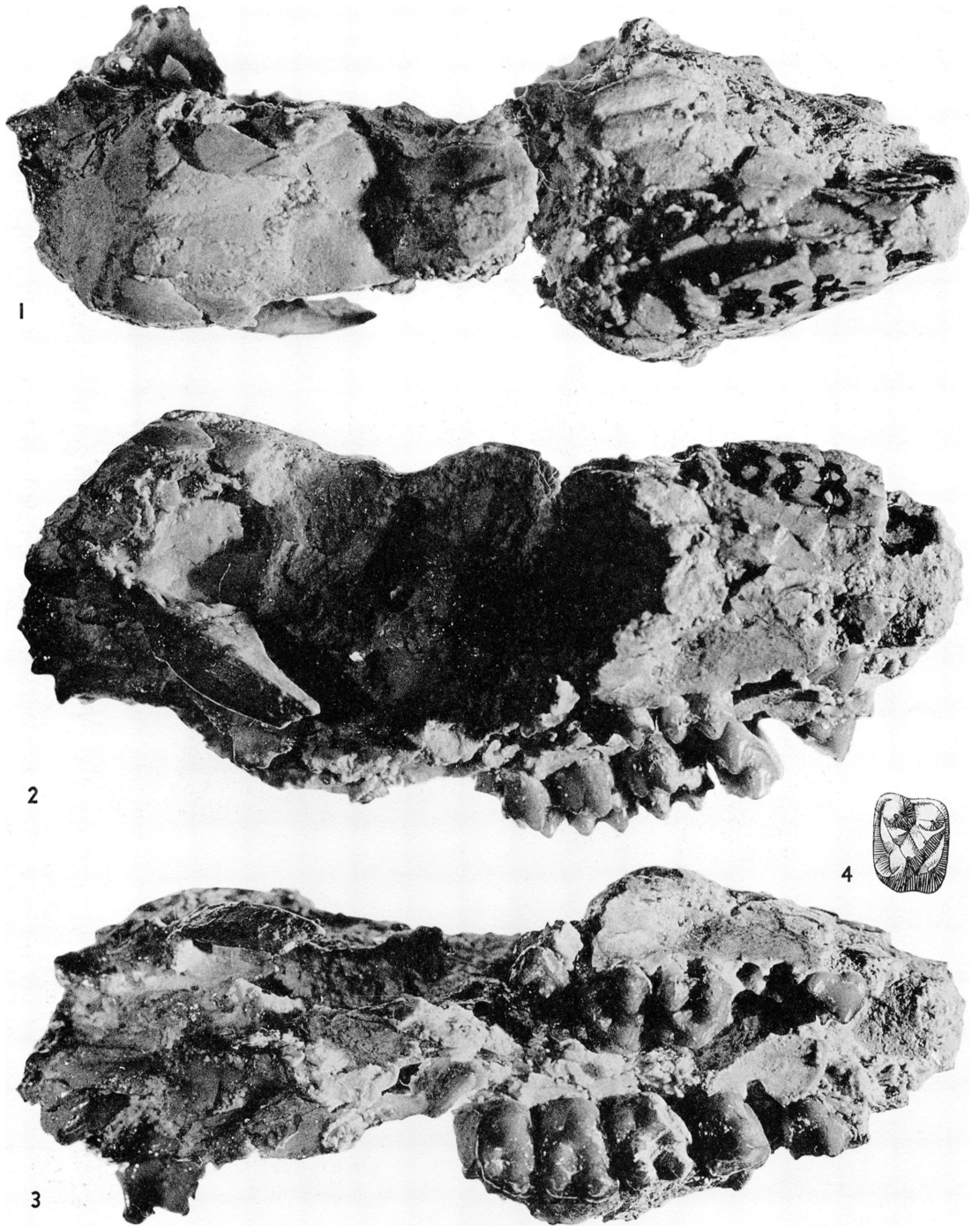
It is interesting to note that there is also very close similarity between the M^{1-2} of *Carodnia* and the M^{2-3} of *Carolozittelia* Ameghino, an ungulate from the Casamayor

CONDYLARTHRA

1–2. *Ernestokokenia protocenica*, new species. 1. M.N.R.J. No. 1430-V, holotype, fragment of left upper jaw with P^{3-4}, M^{1-3}. × 2. 2. M.N.R.J. No. 1431-V, paratype, part of left lower jaw with M_{1-3}, crown view. × 2

3–5. *Ernestokokenia parayirunhor*, new species. 3. M.N.R.J. No. 1468-V, holotype, right lower jaw with C, P_{3-4}, M_{1-3}, crown view. × 2½. 4. Same. External view. × 1. 5. D.G.M. No. 305-M, paratype, part of left upper jaw with M^{2-3}, crown view. × 2½

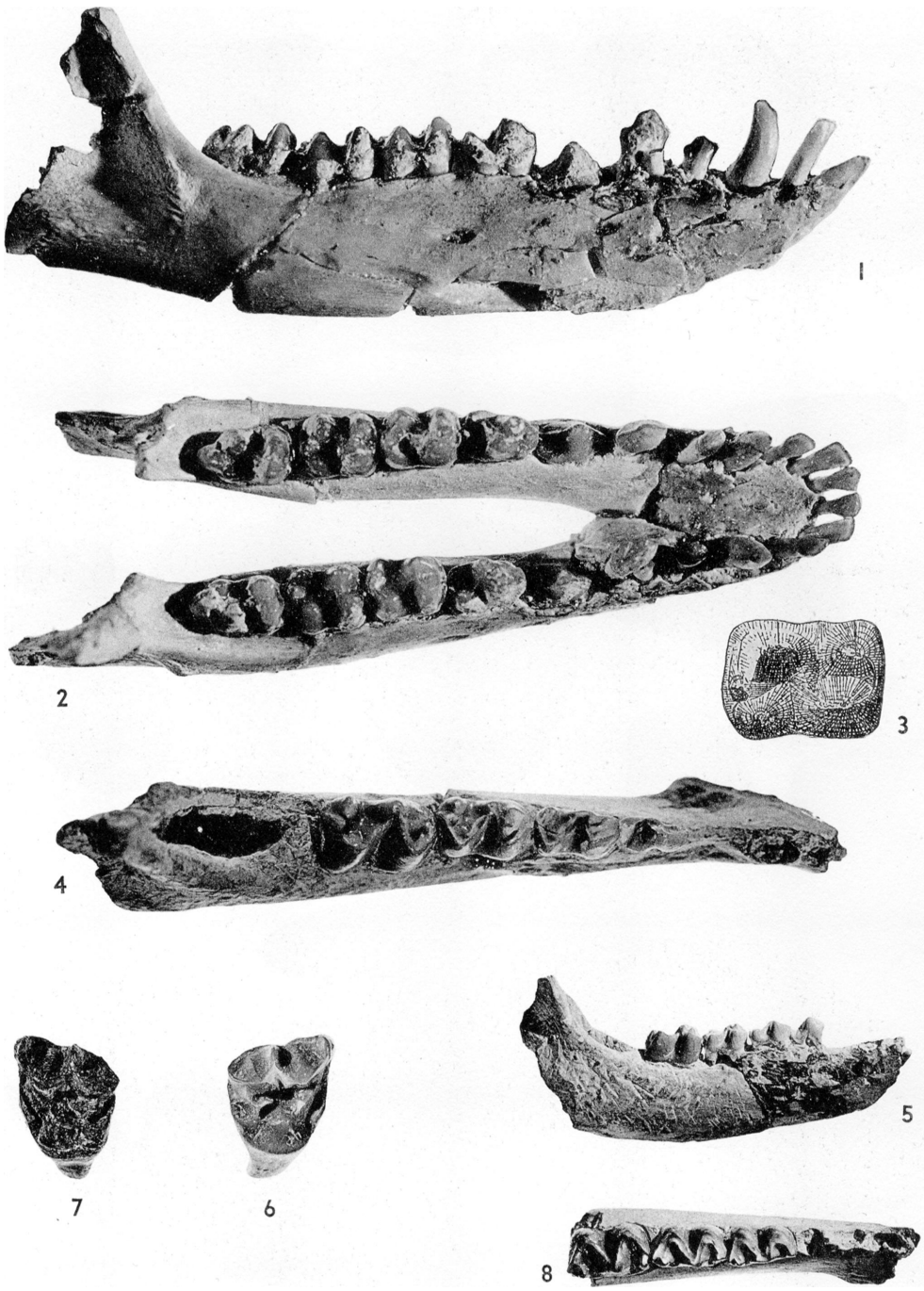
6–8. *Lamegoia conodonta*, new genus, new species. 6. M.N.R.J. No. 1463-V, holotype, left $M_{?2}$, crown view. × 2. 7. M.N.R.J. No. 1465-V, paratype, right M^2, crown view. × 2. 8. M.N.R.J. No. 1464-V, paratype, left M^1, crown view. × 2



CONDYLARTHRA

1–3. *Asmithwoodwardia scotti*, new species. D.G.M. No. 358-M, holotype, incomplete skull with right P^3, M^{1-3}, and left P^{3-4}, M^{1-3}. × 3. 1. Dorsal view. 2. Right side view. 3. Palatal view

4. *Asmithwoodwardia subtrigona* Ameghino, 1901. M.A.C.N. No. 10723, holotype, left M^2 (?). Crown view. × 3. After Ameghino



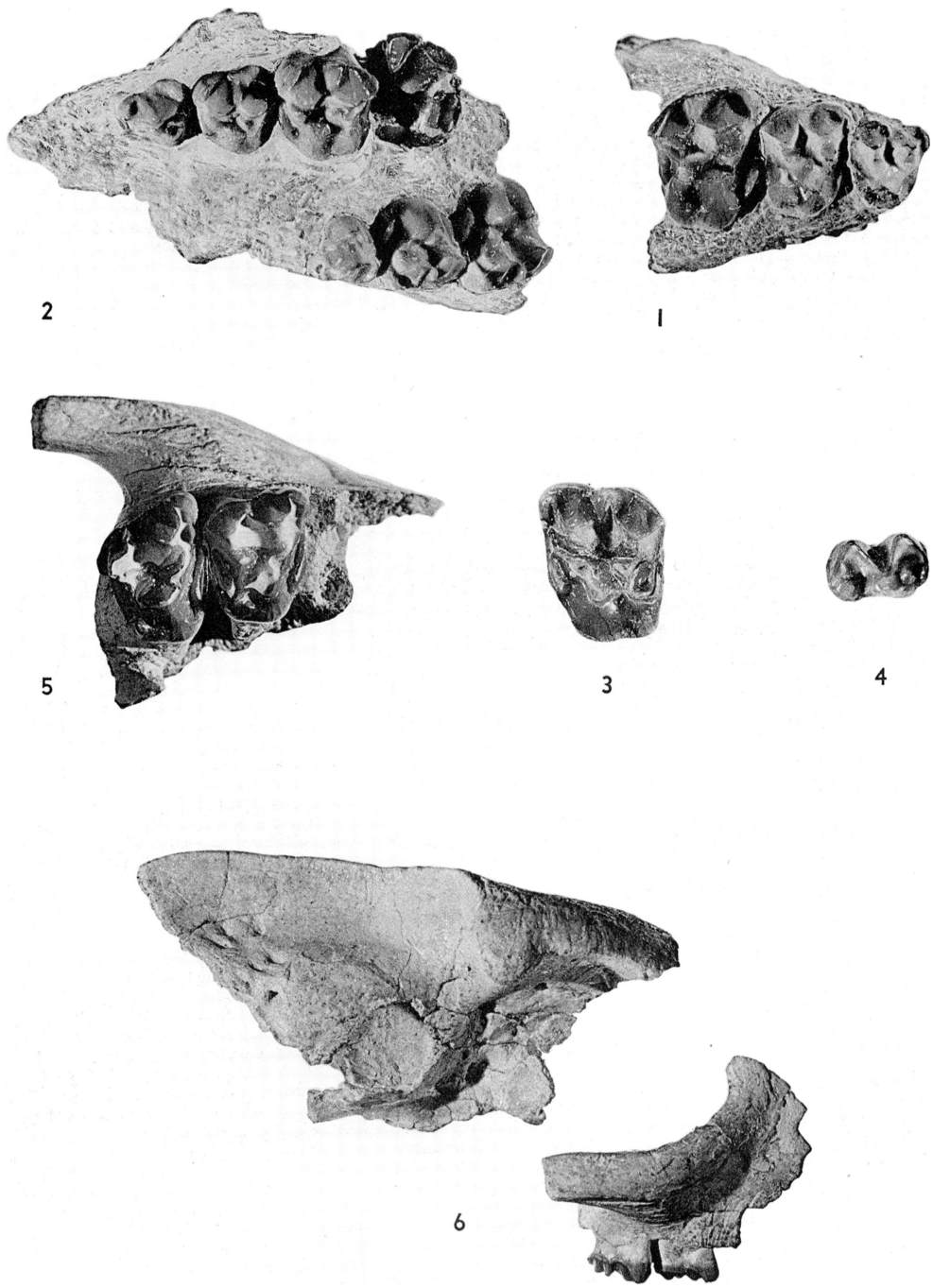
CONDYLARTHRA AND LITOPTERNA

1–2. *Asmithwoodwardia scotti*, new species. D.G.M. No. 358-M, holotype, almost complete and laterally compressed lower jaw with complete dentition. × 3. 1. External side of the right lower jaw. 2. Crown view

3. *Asmithwoodwardia subtrigona* Ameghino, 1901. M.A.C.N. No. 10723, holotype, M_1 or M_2. Crown view. × 5. After Ameghino

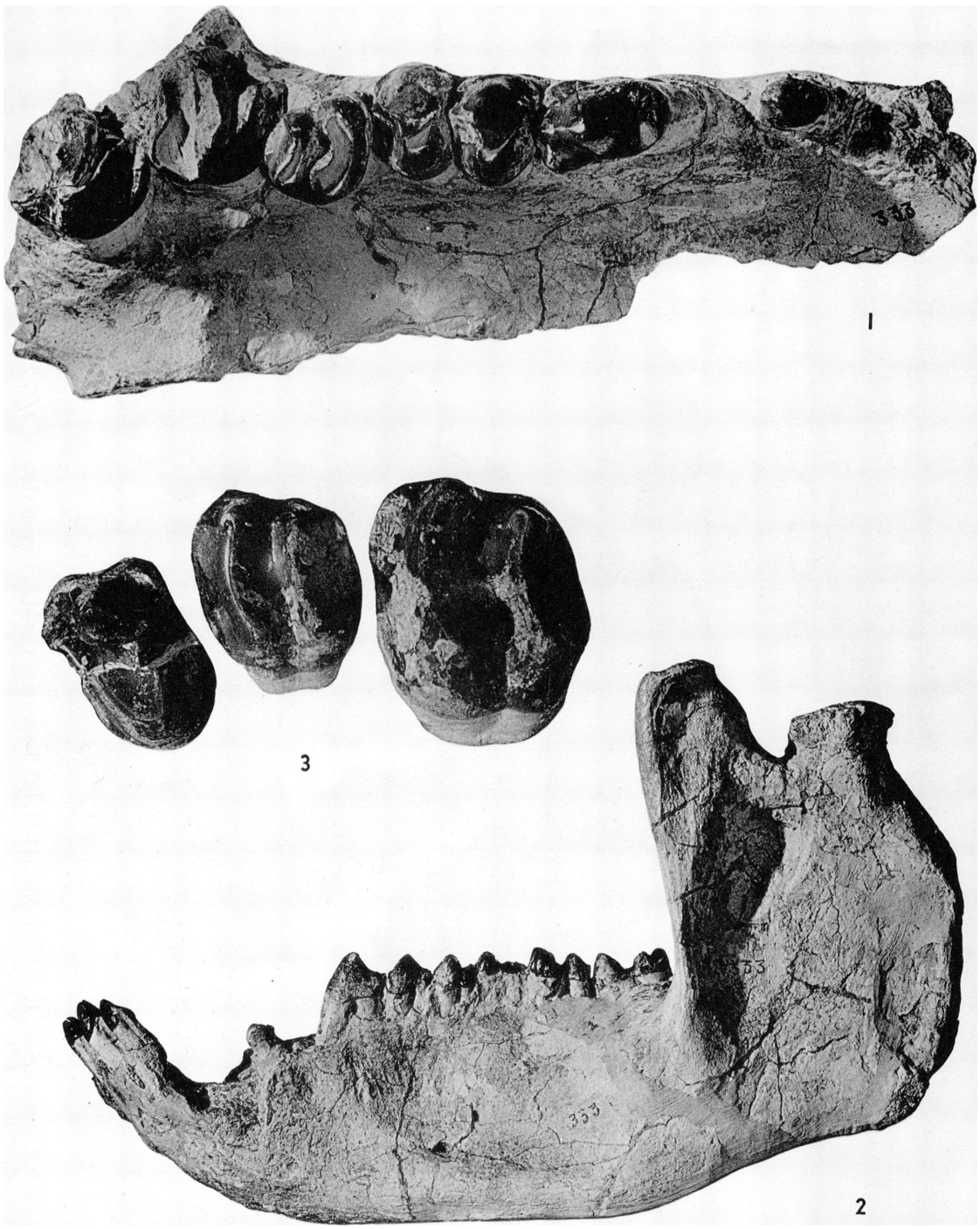
4–5. *Anisolambda prodromus*, new species. D.G.M. No. 262-M, holotype, incomplete right lower jaw with apex of DI_3 in the alveolus, root of C, and with P_2, DM_{3-4}, and M_1. 4. Crown view. × 2. 5. External view. × 1

6–8. *Victorlemoinea prototypica*, new species. 6. M.N.R.J. No. 1470-V, holotype, right M^2 or M^3, crown view. × 1. 7. M.N.R.J. No. 1471-V, paratype, left M^3, crown view. × 1. 8. D.G.M. No. 268-M, fragment of left lower jaw with $P_{3-4(?)}$, and $M_{1?}$, crown view. × 1



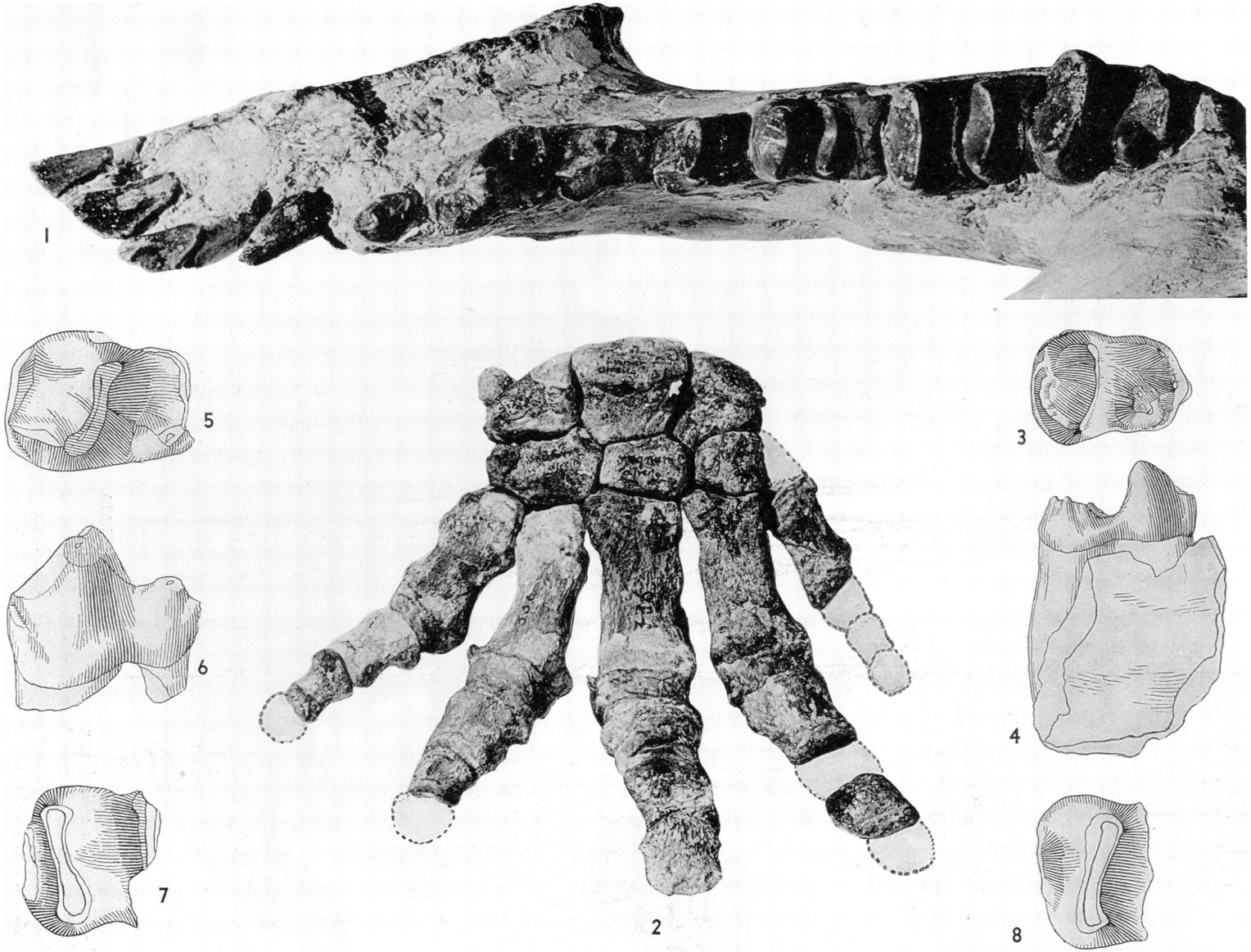
LITOPTERNA

1–6. *Anisolambda prodromus*, new species. 1. D.G.M. No. 304-M, paratype, partial right upper jaw with DM^{3-4}, M^1, crown view. × 2. 2. D.G.M. No. 273-M, paratype, fragment of right and left upper jaw with right and left P^2 and DM^{3-4}, and left M^1 erupting, palatal view. × 2. 3. M.N.R.J. No. 1479-V, left $M^{?2}$, crown view. × 1½. 4. M.N.R.J. No. 1493-V, right $M_{?2}$, crown view. × 1½. 5–6. D.G.M. No. 310-M, fragment of right upper jaw with M^{2-3}, and incomplete posterior part of the skull. 5. Fragment of right upper jaw, palatal view. × 1½. 6. Same and posterior fragment of the skull, right side view. × 1



XENUNGULATA

1–3. *Carodnia vieirai*, new species. 1. D.G.M. No. 333-M, holotype, part of right upper jaw with P^{1-4}, M^{1}, and incomplete M^{2-3}. Crown view. Approximately × 7/10. 2. D.G.M. No. 333-M, holotype, left lower jaw with I_{1-3}, P_{1-4}, M_{1-3}, external side view. Approximately × 3/8. 3. D.G.M. No. 335-M, left P^{4}–M^{2}. × 1.

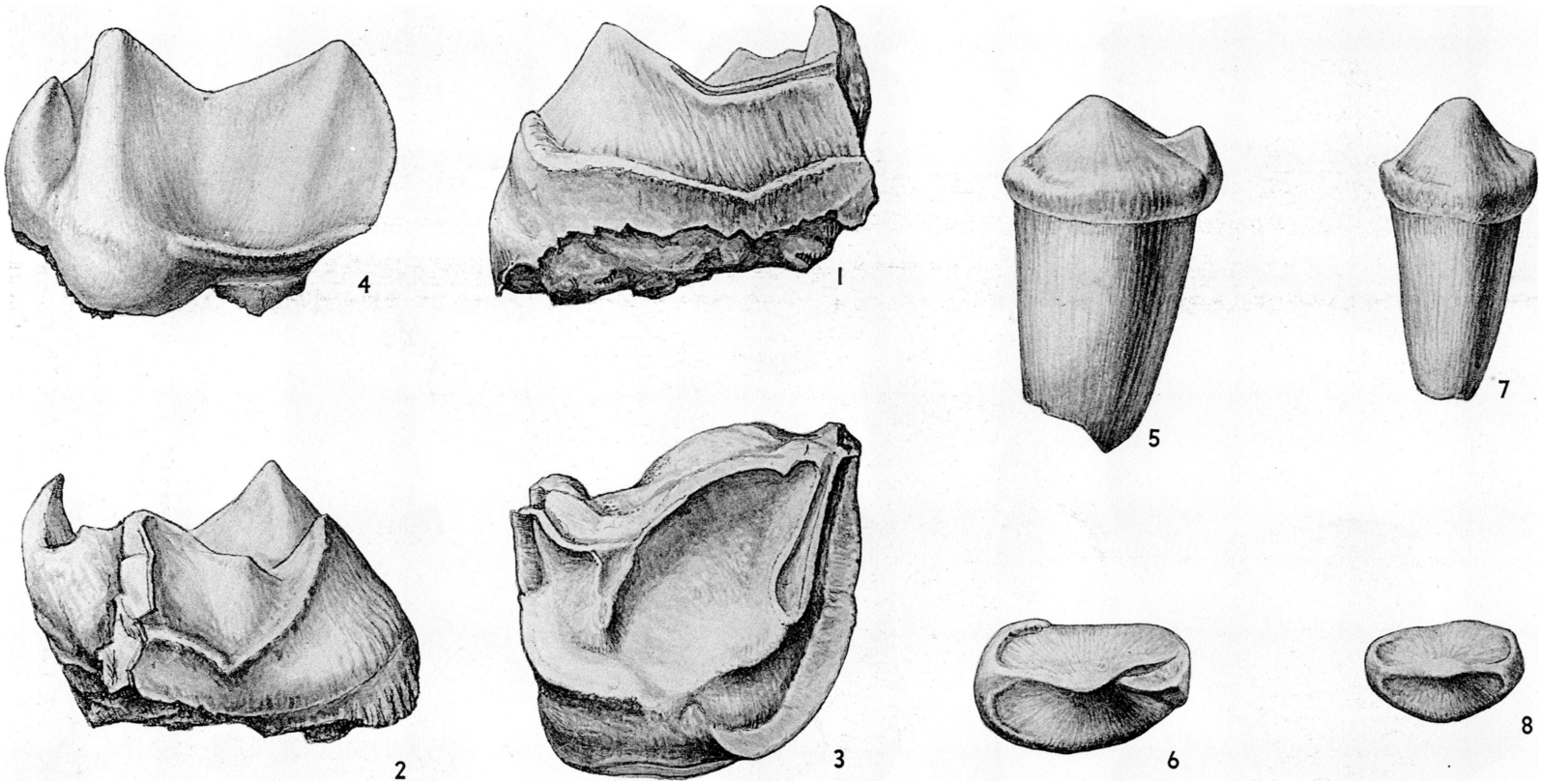


XENUNGULATA

1–2. *Carodnia vieirai*, new species. 1. D.G.M. No. 334-M, left lower teeth (I_1–M_3). Crown view. × 2/3. 2. D.G.M. No. 336-M, right manus. Front view. Approximately × 1/2

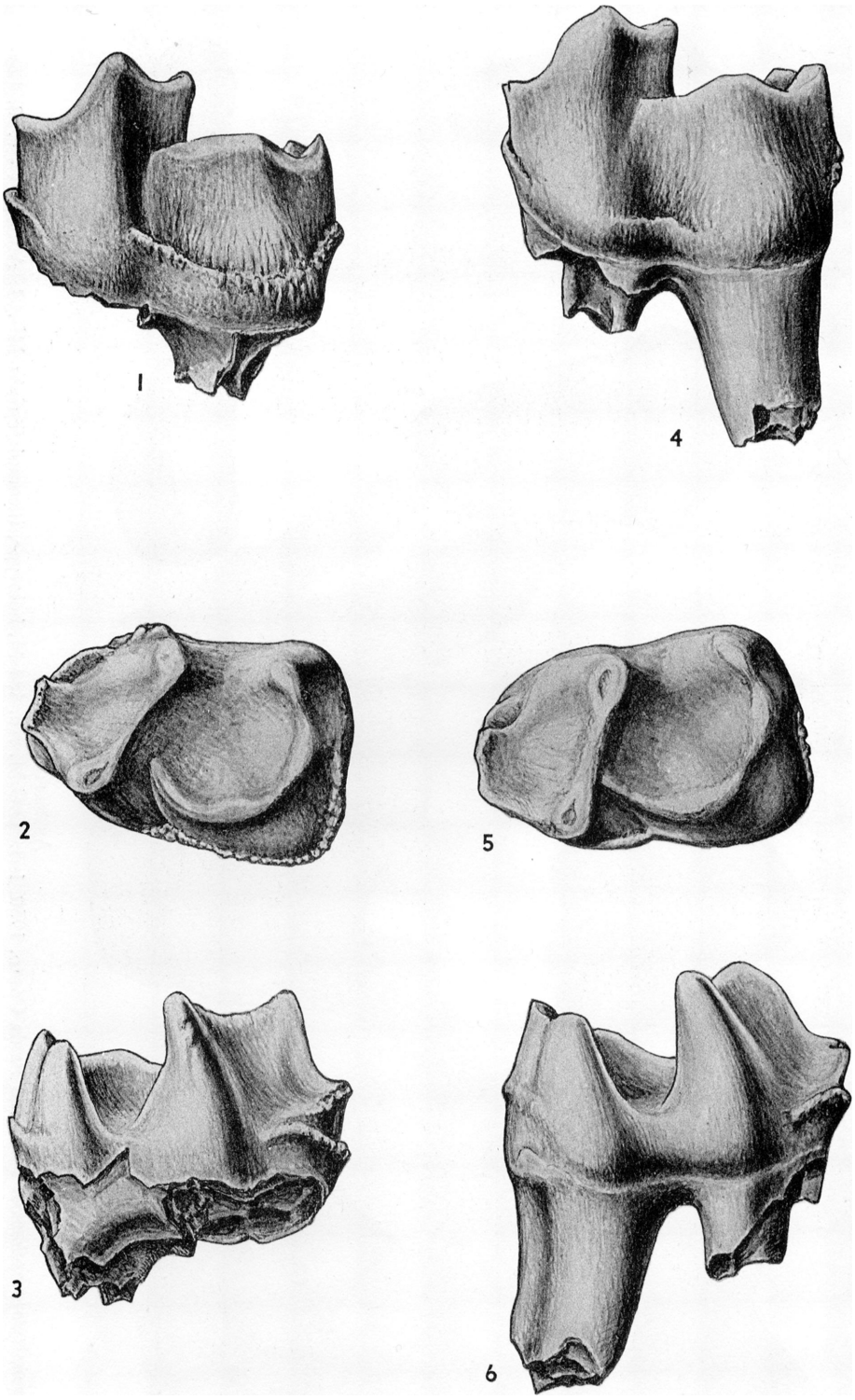
3–4. *Carodnia feruglioi* Simpson, 1935. Feruglio collection, type, left M_3. Crown (3) and internal (4) views. × 1. After Simpson

5–8. *Carodnia cabrerai* (Simpson, 1935). Feruglio collection, type. × 2. 5–6. Left P^4 almost complete. Crown (5) and external side (6) views. 7. Talonid and part of trigonid of right M_1. Crown view. 8. Talonid of left M_1. Crown view



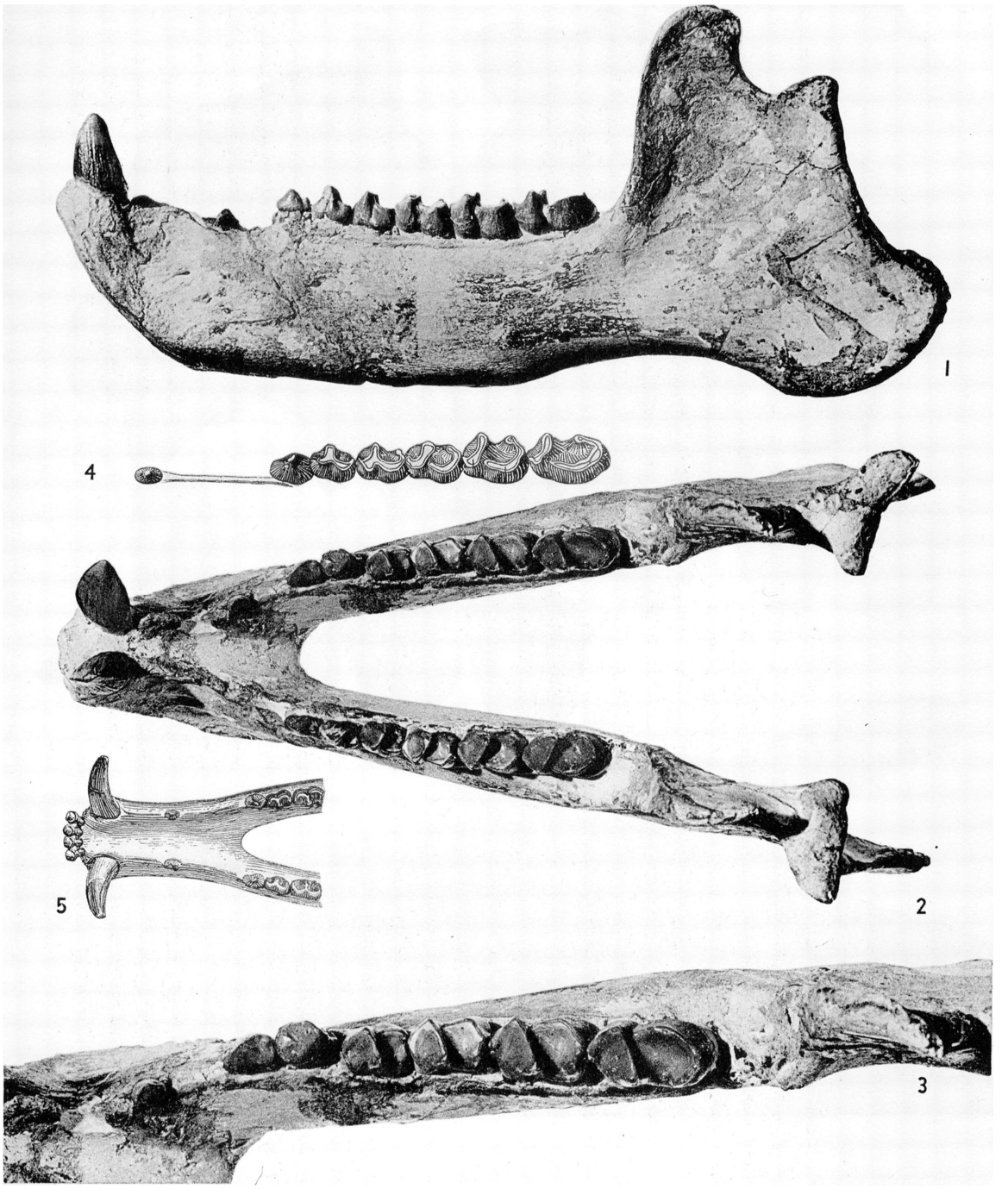
ASTRAPOTHERIA

1–8. *Trigonostylops apthomasi* Price and Paula Couto, 1950. 1–3. D.G.M. No. 154-M, holotype, incomplete right $M^{?1}$. 1. Anterior view. 2. Posterior view. 3. Crown view. 4. D.G.M. No. 156-M, paratype, ectoloph of a right upper molar. External side. 5–6. D.G.M. No. 159-M, lower left premolar. 5. External side. 6. Crown view. 7–8. D.G.M. No. 160-M, lower left premolar. 7. External side. 8. Crown view. All figures × 4½. From Price and Paula Couto, 1950



ASTRAPOTHERIA

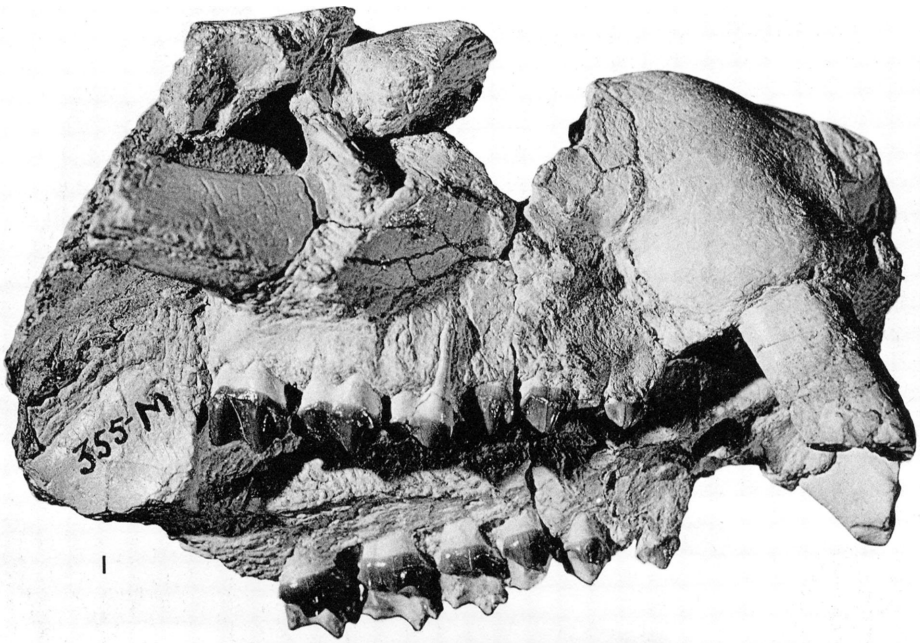
1–8. *Trigonostylops apthomasi* Price and Paula Couto, 1950. D.G.M. No. 155-M, paratypes. 1–3. Left P_4. 1. External side. 2. Crown view. 3. Internal side. 4–6. Left M_1. 4. External side. 5. Crown view. 6. Internal side. All figures × 4½. From Price and Paula Couto, 1950



ASTRAPOTHERIA

1–3. *Trigonostylops apthomasi* Price and Paula Couto, 1950. D.G.M. No. 309-M, mandible with both C, right P_1, and right and left P_{2-4}, M_{1-3} present. Left external side view (1), top view (2), and crown view (3) of the right cheek teeth. 1–2. Approximately × 5/6; 3, approximately × 5/4

4–5. *Trigonostylops wortmani*, 1897. Museum d'Histoire Naturelle, Paris. 4. Left cheek teeth (P_1–M_3). Crown view. Approximately × 5/6. From Gaudry. 5. Mandible. Top view of the anterior part, showing the incisors (I_{2-3}?), canines, and premolars (P_{1-4}) of both sides. × 3/10. From Gaudry



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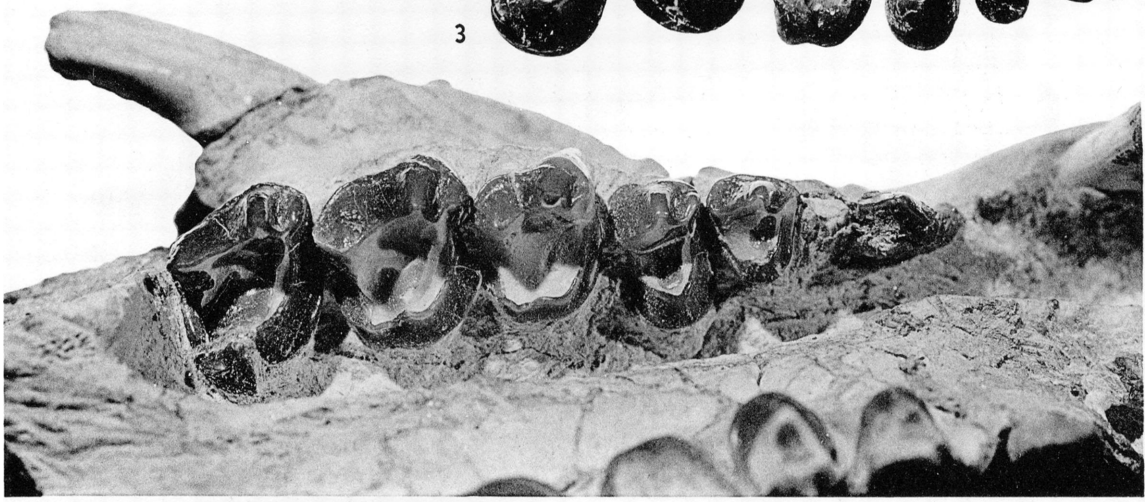

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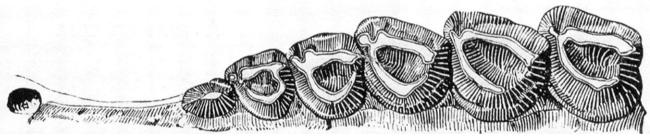
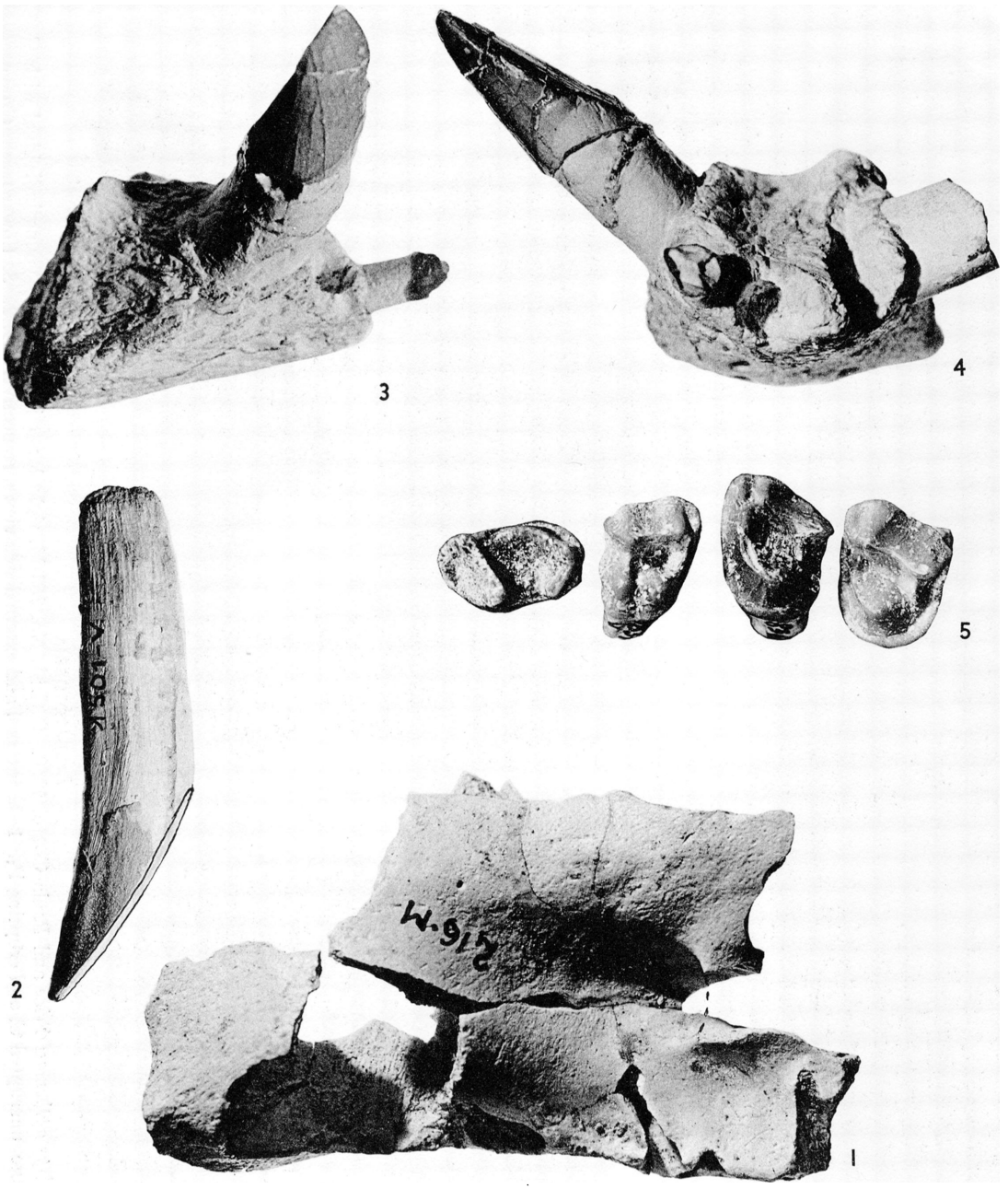


4

ASTRAPOTHERIA

1–3. *Trigonostylops apthomasi* Price and Paula Couto, 1950. D.G.M. No. 355-M. 1. Fragment of the anterior part of the skull. Right side view. × 1. 2. Right P^2–M^3. Crown view. × 1½. 3. M.N.R.J. Nos. 1599-V, 1602-V, 1610-V, 1616-V, 1632-V, and 1655-V, composite upper right P^2–M^3 series. Crown view. × 1½

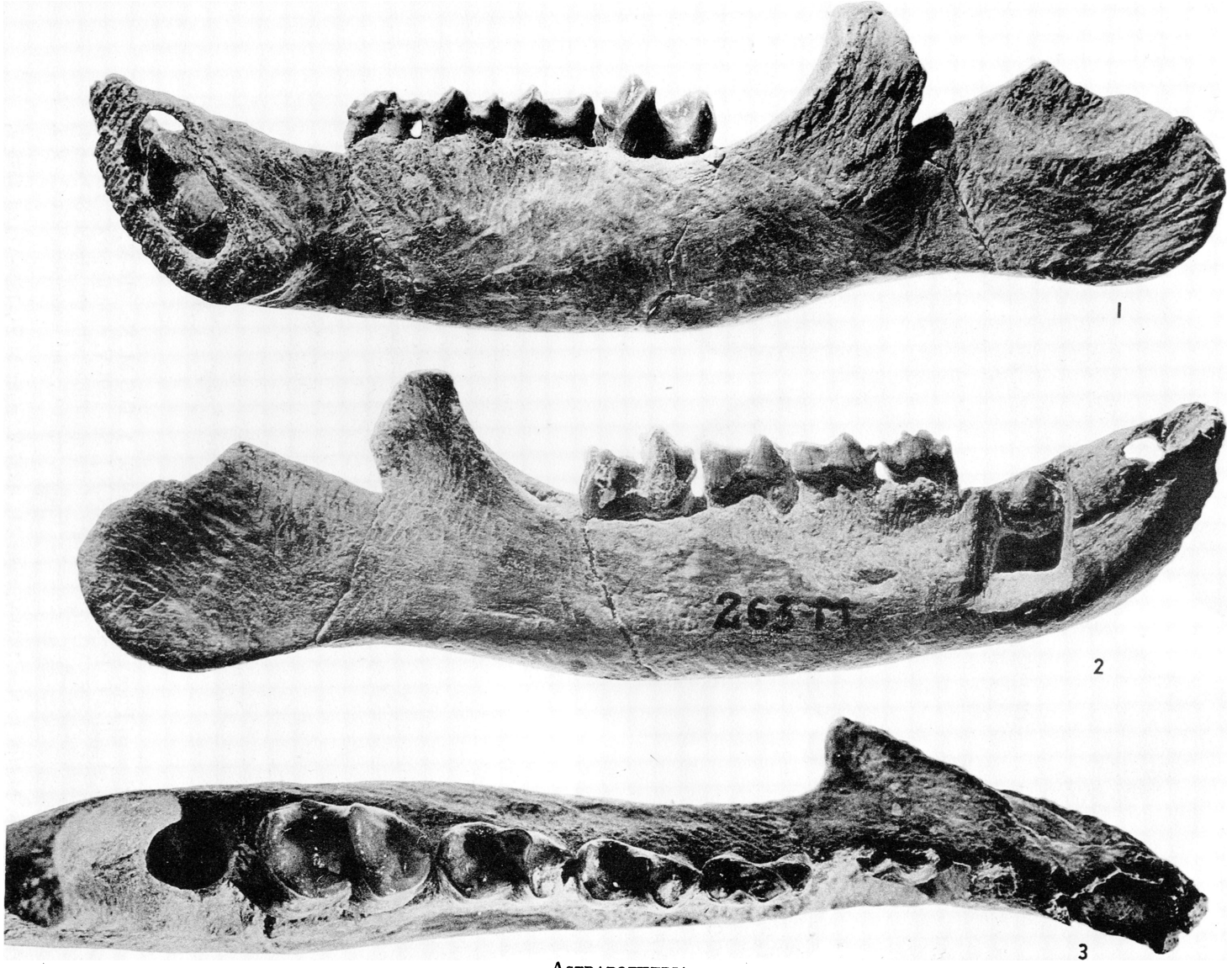
4. *Trigonostylops wortmani* Ameghino, 1897. Museum d'Histoire Naturelle, Paris. Left P^2–M^3. Crown view. × 1. From Gaudry



ASTRAPOTHERIA

1–4. *Trigonostylops apthomasi* Price and Paula Couto, 1950. 1. D.G.M. No. 216-M, fragment of left upper jaw with partial alveoli of C, P^{1-3}. × 2. 2. M.N.R.J. No. 1501-V, right upper C. External side view. × 1. 3–4. D.G.M. No. 355-M, anterior part of the mandible with the alveoli of both I_1 and I_3, the root of left I_2, and the right I_2, somewhat broken, right C, and incomplete left C. × 2. 3. Right side view. 4. Front view

5. *Trigonostylops* sp. M.N.R.J. Nos. 1839-V, right M_3, 1837-V, right $M^{1(?)}$, 1836-V and 1598-V, left M^3, unassociated. Crown view. Approximately × 1⅘



ASTRAPOTHERIA

1–3. *Trigonostylops apthomasi* Price and Paula Couto, 1950. D.G.M. No. 263-M, right lower jaw of a very young individual with DM_{2-4} and M_1 in use, unerupted C, and erupting P_1. 1–2. Internal and external side views, respectively. × 2. 3. Lower teeth. Crown view. × 3

formation (lower Eocene) of Patagonia, classified among the Pyrotheria.

MANDIBLE AND LOWER DENTITION: The holotype mandible (D.G.M. No. 333-M) is almost complete. It is strong, high and relatively short, and slightly deformed by compression. A small mental foramen is placed on the posterior part of the lower border of the symphysis, under the canine; three other foramina are seen on the external side, near the lower border, one under P_1, another under the posterior part of P_2, and the last under P_4. The lower border of the mandible is more or less parallel to the alveolar border, except on its anterior part, where it rises abruptly from below the canines to the incisor border. The symphysis is wide and deep, reaching the posterior border of P_4, with its upper surface marked by a deep and concave groove.

The right and left I_1 and the left I_{2-3} are present. They are compressed laterally, chisel-shaped, with the crown completely covered by a slightly grooved coat of enamel, and with convex anterior face, the posterior one being slightly excavated and laterally limited by well-pronounced or weak ridges of the enamel. The anterior and posterior faces meet at the tip, forming at the intersection a dihedral angle of approximately 40 degrees.

The lower canines are absent in the holotype (the root of the right one is seen in its alveolus). They are known by two isolated specimens, with the same number (D.G.M. No. 333-M) but surely from another individual. They are similar to the upper canines, convex anteriorly, with the root very procumbent, but with the tip turned up. When unworn, the crown is completely covered by a slightly corrugated coat of enamel. The wear of the crown is produced on its posterior face, which loses its enamel and becomes progressively flatter with wear, which is produced by friction with the anterior face of the upper canine, as in the astrapotheres, for example.

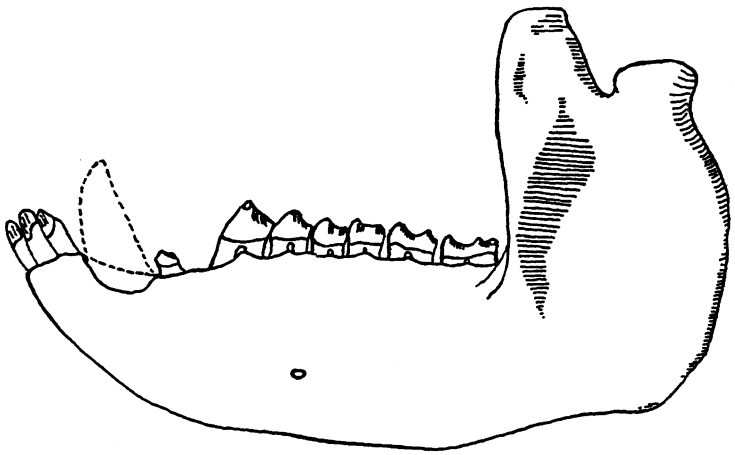


FIG. 2. *Carodnia vieirai*, new species. D.G.M. No. 333-M, holotype. Mandible, left external side view. ×1/4.

The left cheek teeth are all present in the holotype (D.G.M. No. 333-M), but the right P_{1-3} are represented only by their roots, and the right P_4–M_1 are somewhat broken, the right M_{2-3} being complete.

P_{1-2} are compressed laterally, longer than wide. P_1 is very small, single-rooted. It has a more or less mesial and transverse main cusp, from which sharp anterior and posterior ridges run down to a vestigial cuspule on the middle part of the anterior and posterior faces of the tooth. The wear begins on the external side of the cusp and of the ridge. P_2 is very large, much longer than wide, double-rooted, with a strong mesial, and slightly anterior main cusp, followed by a low talonid, which is a little wider, but shorter, than the

TABLE 6

MEASUREMENTS (IN MILLIMETERS) OF THE UPPER TEETH OF THE HOLOTYPE OF *Carodnia vieirai*, NEW SPECIES (D.G.M. No. 333-M)

(Measurements of a referred specimen, D.G.M. No. 335-M, are in parentheses.)

	Width of Crown at Apex	Antero-posterior Thickness at Base of Crown	Width of Middle Part of Root (Isolated Tooth)	Antero-posterior Thickness at Middle Part of Root (Isolated Tooth)	Length at Base of Crown	Width at Base of Crown
I?^{3}	(13)	(18.8)				
C			30.5	35		
P^1					16.1	11.2
					(18.8)	(17.2)
P^2					29	19.8
					(32)	(20.2)
P^3					19.3	24
					(23)	(25)
P^4					18.2	25
					(18.7)	(28.5)
M^1					22.2	25
					(23.7)	(28)
M^2					28[a]	31.5[a]
					(30.5)	(35)
M^3					—	—
					(32)	(39.8)

[a] Approximate.

anterior part. The main cusp is marked on the midline of its anterior face by a sharp ridge, which runs down from its tip to the weak and short anterior cingulum; another crest runs down posteriorly from its tip, following the median line until about halfway down the crown, where it turns inward and ends before reaching the internal face of the tooth. The talonid is marked on the midline of its top by a short and weak ridge, which runs down from the posterior ridge of the main cusp at the point where it turns to the internal side to a small cuspule on the postero-external corner of the talonid.

P_3 is more or less similar to P_2, but it is smaller, its ridges are stronger, and its talonid is relatively longer than that of P_2, but less wide than the anterior part of the tooth, having sometimes on its postero-internal corner a small accessory cusp in line with the postero-external one and connected with the latter by a low, smooth ridge. A very low metalophid runs down from the hypoconid to the postero-internal corner. There is a strong, anterior, basal cingulum, divided into two parts by the anterior ridge of the main cusp.

P_4 is somewhat molariform, with two high, anterior main cusps, more or less conical, placed side by side, and connected by a transverse ridge (protolophid), somewhat concave anteriorly, and a low, short, but wide posterior talonid. The antero-internal main cusp, which is homologous with the mesial main cusp of the anterior premolars, has its tip connected with the antero-external corner of the trigonid by a sharp ridge, which divides the wide anterior cingulum into two parts. Another less definite, rounded ridge runs downward and forward from the metaconid but ends before reaching the anterior border of the tooth. The talonid is similar to that of P_3, but it is slightly wider than the trigonid, and its crest is a little higher and

sharper and somewhat crenulated.

M_{1-2} are perfectly tapiroid, with two strong and slightly oblique, transverse, parallel ridges (protolophid and metalophid), somewhat concave anteriorly and superiorly, rising to a cusp at each end, and with a deep, transverse, mesial valley, open at each end. There are weak anterior and wide posterior basal cingula, the anterior one mesial or running to the antero-external corner, and the posterior one extending from the external end of the base of the entoconid to the postero-external corner of the tooth. There are no external or internal cingula. The posterior transverse crest of M_1 is as wide as the anterior one, but on M_2 it is much less wide. M_2 is much larger than the anterior cheek teeth.

M_3 is a little larger than M_2, and quite different from the anterior molars, in the structure of its talonid, which is lower and longer, but less wide than the trigonid, and lacking a metalophid. It has a strong, conical, and more or less isolated hypoconid, a less strong, but higher posteromesial hypoconulid separated from the hypoconid by a deep notch, and a more or less distinct entoconid connected with the hypoconulid by a sharp, transverse, papillated crest. The anterior cingulum is as on M_2. The posterior cingulum runs from the base of the hypoconulid to that of the protoconid, across the hypoconid.

VERTEBRAL COLUMN: The section of the vertebral column known is limited to the cervical and to the two first dorsal vertebrae.

The atlas is strong and presents the general ungulate aspect. The two anterior articular facets almost meet above in the midline but are well separated below, in harmony with the

TABLE 7

MEASUREMENTS (IN MILLIMETERS) OF THE LOWER TEETH OF THE HOLOTYPE OF *Carodnia vieirai*, NEW SPECIES (D.G.M. No. 333-M)

(Measurements of a referred specimen, D.G.M. No. 334-M, are given in parentheses.)

	Width of Crown at Apex	Rectilineal Height Outside Alveolus	Antero-posterior Diameter Immediately Above Aveolus	Length of Base of Crown	Width at Base of of Crown
I_1	11.5 (12.5)	40 (37.8)	14.2 (17)		
I_2	12.3 (15)	36.8 (35.5)	20 (20)		
I_3	9.5 (12.5)	37[a] (42)	14.5 (15.2)		
C				25	24
P_1				18.9 (17.7)	10.8 (11.7)
P_2				27 (33.5)	16.8 (19.2)
P_3				20.3 (23.8)	16 (16.8)
P_4				19.5 (22.2)	17.8 (18)
M_1				22.4 (25)	19.2 (20.2)
M_2				28.8 (33.5)	27.2 (28.2)
M_3				34 (39)	30.5 (32.5)

[a] Approximate.

occipital condyles. They are deeply concave, and the articular surface is so curved that its lower half forms an angle of about 90 degrees with the upper half. The two posterolateral articular facets are well separated above and below; they are rounded and slightly concave, with a short and narrow lower, mesial prolongation. The posteromedian articular facet, for reception of the odontoid process of the axis, is gently concave, with its larger transverse diameter on the midline. The superior arch of the atlas is massive, but the spinal process is very low and smooth. An opening pierces the superior arch, just above the articular facet for the occipital condyle. The external opening of this foramen is directed to the external side and slightly forward. Another larger foramen (vertebrarterial canal) pierces the transverse process on its lower border, just external to the middle part of the posterolateral articular facet. The upper anterior foramen and the lower posterior one are connected by a weak groove passing outside of the antero-external border of the condylar articular facet and immediately anterior to the base of the transverse process. The neural canal is wide and rounded. The transverse processes are relatively short, narrow, and flat. They are horizontal but turned slightly backward. The external margin is much thicker than the mesial part and is rugose. A well-developed vertebrarterial canal pierces each transverse process at the lower part of its base, just on the midline of the external side of the posterior articular facets.

The axis or epistropheus is strong and also has the general ungulate shape. Its centrum is compressed dorsoventrally on its anterior part, but is almost rounded posteriorly. The odontoid process is well developed. Its dorsoventral diameter is much larger than the transverse one. Its under surface presents two oblique, convex, lateral, articular facets, meeting at the midline in a longitudinal keel, pointed in front. The neural arch is bulky, and the spinal process (broken) was certainly strong. The neural canal is relatively small, compressed laterally. The anterior articular facets are wide, convex, with the anterior end confluent with the base of the odontoid process, and the posterior end lateral to the middle part of the external face of the centrum. They are somewhat longer than high, and their upper and lower borders are approximately parallel. The posterior zygapophyses are relatively small, slightly concave, and oval in outline, with their larger diameter directed anteroposteriorly. The articular facet is directed obliquely from above downward and more outward than downward. The transverse process is very short, narrow, flat, almost vertical, placed lateral to the posterior end of the centrum

TABLE 8

MEASUREMENTS (IN MILLIMETERS) OF THE VERTEBRAE OF A REFERRED SPECIMEN OF *Carodnia vieirai*, NEW SPECIES (D.G.M. No. 336-M)

	Length	Width	Length of Lower Part of Neural Arch	Length of Upper Part of Neural Arch	Width of Neural Canal	Length of Centrum
Atlas	60	197	32.5	31.2	61.6	—
Axis	90	102[a]	—	—	22.8	—
Third cervical	57	92[a]	—	22.3	33	42
Fourth cervical	55.5	99.5[a]	—	21.5	37.8	44.2
Fifth cervical	51.5	102[a]	—	21.5	38.5	48
Sixth cervical	51.5	115[a]	—	23.5	38.3	44[a]
Seventh cervical	53.7	120[a]	—	22.5	39.2	26
First dorsal	51	137[a]	—	28.3	32.5	48.5
Second dorsal	62.5	151.5	—	33[a]	32[a]	49

[a] Approximate.

and directed obliquely backward. The posterior face of the centrum is rounded and concave. There are no discernible foramina (the cervical artery passed under the base of the short, narrow, transverse process, where there is a shallow groove).

The posterior cervical vertebrae are relatively short and are more or less of the same general shape. The centrum is massive, more or less rounded, opisthocoelous, slightly hollow inferiorly on both sides, and presenting a longitudinal keel on the ventral face. Its anterior and posterior articular facets present strong inferior projections, the posterior one being the larger, especially on the third cervical vertebra, on which it ends in a sharp point. The transverse processes are preserved only on the sixth and seventh cervical vertebrae; they are very short and narrow, but well developed dorsoventrally, concave on the upper face and convex below. They are pierced by an oval or rounded vertebrarterial canal (absent on the seventh cervical vertebra). The neural arch is strong, with a very short spinal process (absent on the third cervical vertebra); the neural canal is large and more or less rounded. The anterior zygapophyses are oval in outline, slightly convex, with the articular facet directed obliquely from above downward and more inward than upward. The postzygapophyses are larger, oriented like those of the axis. The sixth and seventh cervical vertebrae are pathologically ankylosed, having abnormal exostoses. The last cervical vertebra differs from the preceding vertebrae mostly in the fact that it presents on each side of the posterior end of the centrum an articular facet for the reception of the anterior part of the capitulum of the first dorsal rib.

The first two dorsal vertebrae are cemented together. They are strong and wider than the cervical vertebrae. The centrum is similar to that of the last cervical but slightly longer. The transverse processes are strong, tubercled, and well developed. The articular facet for the reception of the tuberculum of the rib is more or less oval in outline, somewhat concave, and directed downward and slightly forward. An elongated and concave articular facet for the upper part of the capitulum of the rib is seen under the base of the transverse process; another much larger and rounded one lies on each side of the posterior end of the centrum for reception of the anterior end of the capitulum of the ribs. The prezygapophyses of the first dorsal vertebra are orientated in the same way as those of the homologous elements of the cervicals, and differently from those of the second dorsal vertebra, in which the prezygapophyses are low, smaller, and are directed upward and forward, instead of upward and inward. The postzygapophyses have similar orientation on the two first dorsal vertebrae; they are oval in outline, slightly concave, and are directed downward and backward. The neural arch is strong, with a well-developed spinal process (broken). The neural canal is triangular in outline.

RIBS: Only the proximal portion of the first left dorsal rib (D.G.M. No. 333-M) and the end of the right one are preserved, the latter cemented by matrix to the centrum of the last cervical vertebra. These ribs show well-developed tuberculum and capitulum. The capitulum has two articular facets, one on its upper part, for articulation with the first dorsal vertebra, and another convex one, confluent with the first, on its anterior part, to articulate with the large facet situated on the lateral part of the posterior margin of the last cervical vertebra. The tuberculum is a little lower and somewhat smaller than the capitulum, but it is strong and presents a large convex articular surface. The external and internal faces of the rib are flattened and gently curved.

SCAPULA: The left scapula (D.G.M. No. 333-M) is represented only by the proximal articular end. The glenoid cavity is moderately concave, antero-posteriorly, and is approximately ellipsoid in outline, with its greater transverse diameter on the posterior part. In front of the glenoid cavity is a short, rounded, and corrugated process, formed by the coracoid, which is completely fused with the scapula. The spine (fragment) was certainly strong and extended downward almost to the outer border of the glenoid cavity.

HUMERUS: Two incomplete humeri, one right, the other left (D.G.M. No. 333-M), are preserved, both lacking the proximal end. The humerus is strong, somewhat elongate, and resembles in general aspect that of *Uintatherium*. The deltoid crest is stout,

TABLE 9

MEASUREMENTS (IN MILLIMETERS) OF THE FIRST RIB AND THE SCAPULA OF THE HOLOTYPE OF *Carodnia vieirai*, NEW SPECIES (D.G.M. No. 333-M)

First rib	
Longitudinal diameter of capitulum	30.3
Transverse diameter of capitulum	22.3
Longitudinal diameter of tuberculum	18.5
Transverse diameter of tuberculum	17.5
Vertical diameter of neck	19
Transverse diameter of neck	9.8
Length of upper end of rib	61.5
Scapula	
Length of neck	103.4
Length of glenoid cavity	86.5
Width of glenoid cavity (posterior half)	64.8

elongate, straight. The supinator ridge is well developed, wide, slightly concave forward, and presents a rounded contour. The trochlea is strong, with a large ulnar facet, roughly conical, with a wide expansion of its internal border, and a well-rounded, radial facet, much smaller than the opposite one. The epicondyle is strong and rugose, but short; the epitrochlea is small. There is no entepicondylar foramen. A deep pit is present in front and back, above the trochlea, perforating the bone.

FOREARM: The forearm is known by an almost complete right radius and ulna from a young individual (D.G.M. No. 336-M); an almost complete right ulna, a proximal fragment of the right radius, a proximal portion of the left ulna, and a complete left radius of an adult individual (D.G.M. No. 333-M).

These two bones are elongated, and relatively thin and short.

The radius is weaker and much shorter than the ulna. Its proximal articular surface is twice as wide as it is long, anteroposteriorly concave, but transversely convex on the inner side and concave on the outer side. A low, concave, and smooth anteroposterior ridge traverses the superior articular surface outside of the midline and parallel with it, separating the convex from the concave part. This crest coincides with the groove in the trochlea of the humerus. The diaphysis of the radius is less strong than the epiphyses; its transverse section is semicircular anteriorly and flat posteriorly. The distal epiphysis is much enlarged, strong, and nodose, its transverse diameter being the longer; its articular surface has two facets, the larger, external, concave one for the lunar bone, and the internal, much smaller, transversely convex, but anteroposteriorly concave, for the scaphoid bone of the carpus. These two facets are separated by a low, smooth anteroposterior crest, which is anteroposteriorly concave.

The ulna is much longer than the radius. It has a strong olecranon process, which is much prolonged behind the articular surface, compressed laterally and expanded posteriorly. The articular surface for the humerus is divided laterally into two concave, confluent facets, the external one slightly sigmoid and directed forward, and the internal one prolonged inferiorly and directed towards the internal side. The coronoid process between and above these two articular facets is strong, well developed, not allowing a rotation greater than 125 degrees to 130 degrees over the humerus. The diaphysis is flattened anteroposteriorly, mostly on its internal border, which is edged, the external border being much thicker; its transverse section is an isosceles triangle in outline, with its base turned outward. The distal epiphysis is small, and the articular surface for the cuneiform bone of the carpus is small, transversely oval in outline, concave in both directions, slightly turned downward and backward, and with a smooth and very small posteroexternal articular facet for the pisiform.

THE MANUS: The manus is strong, pentadactyl. Seven bones of the carpus are preserved: scaphoid, lunar, cuneiform, and

pisiform, in the proximal row; trapezoid, magnum, and unciform, in the distal row; the trapezium is lacking.

The scaphoid is articulated distally with the trapezium, trapezoid, and magnum and internally with the lunar. The lunar articulates with the scaphoid on its external side, with the cuneiform on its internal side, and with the magnum and unciform inferiorly. The cuneiform is connected with the lunar on its external side and with the unciform on its distal end. The trapezium articulates distally with the first metacarpal bone; the trapezoid, partly with the first, but mostly with the second; the magnum, partly with the second, but mostly with the third; the unciform, partly with the third, but mostly with the fourth and fifth.

The proximal articular surface of the scaphoid is convex, much wider anteriorly than posteriorly. The distal end has two concave articular facets, one for the trapezoid, and the other smaller, somewhat posterior, for the trapezium. These two articular facets are separated by a transverse ridge. The articulation with the lunar is made by means of two flattened facets, one superior, the other inferior, separated by a longitudinal groove, which coincides with that of the lunar. The articular facet for the magnum is situated on an inferior prolongation of the scaphoid; it is confluent, at right angles with the inferior articular facet for the lunar, and it is elongated and convex anteroposteriorly. Perhaps this inferior prolongation of the scaphoid represents the central bone, coalescent with the scaphoid, as in the Dinocerata.

The lunar is the largest bone of the carpus. It is roughly cubical in shape, with a large proximal articular surface for the radius, convex antero-posteriorly and wider than long. Its distal articular surface for the

TABLE 10

MEASUREMENTS (IN MILLIMETERS) OF THE HUMERUS, RADIUS, AND ULNA OF THE HOLOTYPE OF *Carodnia vieirai*, NEW SPECIES (D.G.M. No. 333-M)

(Measurements of a referred specimen, D.G.M. No. 336-M, are given in parentheses.)

Humerus	
Transverse diameter at level of deltoideum crest	71
Transverse diameter of distal epiphysis	116.5
Transverse diameter of trochlea at upper part	69
Transverse diameter of trochlea at lower border	74
Vertical diameter of trochlea	76.5
Width of olecranal foramen	48.5
Radius	
Length	286.5 (223)
Width of proximal epiphysis	65.3 (60.2)
Transverse diameter of proximal epiphysis	35.5 (29)
Width of distal epiphysis	72 (68.8)
Transverse diameter of distal epiphysis	60.3 (54.3)
Anteroposterior diameter of diaphysis	37 (22)
Ulna	
Length	370[a] (295.5)[a]
Transverse diameter of neck of ulna	93.5 (75)
Transverse diameter of glenoid depression	61 (47.5)
Height of great sigmoid cavity	70.5 (67)
Transverse diameter of great sigmoid cavity	75 (66)
Transverse diameter of small sigmoid cavity	41.5 (35.3)
Minimum diameter of sigmoid cavity	33.5 (32.5)
Transverse diameter of olecranon	— (45)
Width of distal epiphysis	46 (—)
Anteroposterior diameter of distal epiphysis	39.5 (—)
Anteroposterior diameter of diaphysis	45 (36.8)

[a] Approximate.

TABLE 11

MEASUREMENTS (IN MILLIMETERS) OF THE CARPAL BONES OF THE HOLOTYPE OF *Carodnia vieirai*, NEW SPECIES (D.G.M. No. 333-M)

(Measurements of a referred specimen, D.G.M. No. 336-M, are given in parentheses.)

	Scaphoid	Lunar	Cunei-form	Pisi-form	Trape-zoid	Mag-num	Unci-form
Longitudinal diameter	57.5 (51.3)	51.5 (45.2)	35 (28)	69.5 (60.6)	31.5 (29.2)	48.5 (42)	41 (34.5)
Transverse diameter	—	48 (38.8)	57 (46)	—	29.2 (30.9)	33 (28.5)	50.5 (44)
Transverse diameter at mid-line	29 (25)	—	—	10.9 (10.5)	—	—	—
Anteroposterior diameter of radial facet	44.4 (42.9)	31.3 (29.8)	—	—	—	—	—
Transverse diameter of radial facet (anterior)	32 (30)	48 (38.8)	—	—	—	—	—
Transverse diameter of radial facet (posterior)	17.8 (13.8)	—	—	—	—	—	—
Anteroposterior diameter of trapezoid facet	40 (37)	—	—	—	—	—	—
Transverse diameter of trape-zoid facet	27.2 (24.5)	—	—	—	—	—	—
Anteroposterior diameter of facet for magnum	30.5 (25)	36.5 (33.5)	—	—	—	—	—
Transverse diameter of facet for magnum	14.2 (13)	20.5 (16.5)	—	—	—	—	—
Anteroposterior diameter of facet for unciform	—	31.5 (28)	25.5 (22)	—	—	—	—
Transverse diameter of facet for unciform	—	20.5 (15)	40.5 (33.5)	—	—	—	—
Anteroposterior diameter of ulnar facet	—	—	33.5 (24)	20 (16)	—	—	—
Transverse diameter of ulnar facet	—	—	48 (41)	11.2 (10)	—	—	—
Transverse diameter at proxi-mal end	—	—	—	25 (21)	—	—	—
Transverse diameter at distal end	—	—	—	18 (16.5)	—	—	—
Vertical diameter at proximal end	—	—	—	30 (22)	—	—	—
Vertical diameter at distal end	—	—	—	33 (30.5)	—	—	—
Transverse diameter of fact for cuneiform	—	—	—	24.5 (21.2)	—	—	32 (31)
Anteroposterior diameter of facet for cuneiform	—	—	—	—	—	—	26 (18.5)
Vertical diameter of facet for cuneiform	—	—	—	11.2 (9)	—	—	—
Anteroposterior diameter of facet for scaphoid	—	—	—	—	30 (24)	—	—
Transverse diameter of facet for scaphoid	—	—	—	—	29.5 (28.5)	—	—
Anteroposterior diameter of distal articular facet	—	—	—	—	31 (26.5)	32.5 (31.5)	31.6 (26.5)
Transverse diameter of distal articular facet	—	—	—	—	23.5 (27)	26.2 (25)	40.5 (36)
Vertical diameter of facet for trapezium	—	—	—	—	12 (10.5)	—	—
Anteroposterior diameter of facet for trapezium	—	—	—	—	21.2 (14.5)	—	—
Anteroposterior diameter of lunar facet	—	—	—	—	—	37 (29)	—
Transverse diameter of lunar facet	—	—	—	—	—	19 (16.5)	—

magnum is divided into two halves, the anterior one flat and the posterior one quite concave and placed a little above the level of the first. Its articulation with the scaphoid is by means of two small facets, one superior, the other inferior, separated by a longitudinal groove. On the opposite side the lunar articulates with the cuneiform by means of a flat, longitudinal facet confluent at right angles with the upper articular surface for the radius, and with the unciform, for which it has a concave longitudinal facet placed inferiorly and looking outward and downward. The cuneiform is a flat bone, much wider than long. It has a large, convex articular surface for the ulna, completely covering its proximal end. The articular surface for the unciform on its distal end is anteroposteriorly concave and becomes narrower on its external end. The articular facet for the pisiform is elongated, flat, and situated along the upper margin of the posterior face of the bone, where it is confluent, at right angles, with the articular facet for the ulna.

The pisiform is well developed, laterally compressed, laminar. Its proximal end has a transversely elongated and slightly convex articular facet for the cuneiform, surmounted on its terminal end by a vertical laminar process, which bears a small, concave, internal articular facet for the ulna. The distal end of the bone is roughened and nodose, more or less rounded posteriorly, enlarged upward and downward, and thicker than the median part of the bone.

The trapezium is lacking. It seems to have been a small bone, articulated with the posterior part of the scaphoid and with the trapezoid and the first metacarpal.

The trapezoid is very small, the smallest of the preserved carpals. Its upper articular facet for the scaphoid is concave anteroposteriorly, convex transversely, and saddle-shaped. The lateral articular facets for the trapezium and magnum are small, concave, with their greater diameter directed anteroposteriorly; they are confluent, at right angles, on the upper border, with the articular facet for the scaphoid, and on the lower border with the articular facet for the second metacarpal. This last articular facet is quadrangular, with a small posterior projection, and is transversely convex.

The magnum is much compressed vertically, in the anterior or articular portion, and expanded vertically, and nodose posteriorly. The upper articular surface for the lunar is flat or transversely convex on the anterior part and arises abruptly to a posterior dome, where it becomes convex, the angle between its anterior and posterior halves being about 45 degrees. The upper lateral articular surface for the scaphoid is elongated, and concave anteroposteriorly, arising posteriorly to a higher level; it is confluent on its upper border with the articular facet for the lunar, and faces laterally and a little upward. The lateral articular facet for the trapezoid is very short and quite convex; another anteroposteriorly elongated and concave articular facet for the second metacarpal is placed on the antero-inferior part of the internal face of the bone; it is directed downward. On the opposite side, the lateral articular facet for the unciform is very small, flat, quadrangular, almost vertical, and confluent with the upper and the lower articular surfaces of the bone. The distal articular facet for the third metacarpal is large, its greater transverse diameter being on its anterior part, which is flat, almost horizontal, but descends posteriorly to a lower level, where it becomes convex; the angle between its two halves is approximately 30 degrees.

The unciform is large and tetragonal in general shape. Its articulation with the cuneiform is made by an upper, transversely concave and elongated articular surface, which descends from the upper border of the upper lateral articular facet for the lunar, down to the postero-external end of the bone, being twisted posteriorly upon its transverse diameter. The articular facet for the lunar is large and obliquely placed on the supero-anterior corner of the internal side of the bone; it is convex in both directions and more or less trapezoidal in outline and meets at its lower border the very small and flat articular facet for the magnum, the angle between these two facets being 60 degrees. The lower articular facets for the fourth and fifth metacarpals are confluent and slightly concave, the first being horizontal and the second arising outward and a little backward. There is also a transversely elongated and

slightly concave articular facet for the third metacarpal, placed on the lower border of the internal face of the bone.

The metacarpal bones, five in number, are robust, moderately elongated, the middle portion flattened anteroposteriorly.

The first metacarpal is much the smallest of all. Its proximal articular facet is transversely elongated and slightly convex on the external part, slightly concave on the internal end, and approximately elliptical in outline. The distal articular facet for the first phalanx is convex anteroposteriorly, with a small longitudinal depression on the internal half. The distal epiphysis bears a small, nodose, internal process.

The second metacarpal is nearly twice as long as the first. Its proximal epiphysis has three facets: the upper one, much the largest, for the trapezoid, transversely concave, with its greater diameter directed anteroposteriorly; the latero-external one, for the magnum and the third metacarpal, confluent with the first by its upper border, elongated, convex in both directions, and slightly turned up; and the latero-internal one, very small, for the first metacarpal, also confluent with the border of the upper articular facet. The distal epiphysis is robust, quite convex anteroposteriorly, with a slight longitudinal groove on its internal half.

The third metacarpal is the largest. Its upper articular facet for the magnum is convex anteroposteriorly on its anterior part and concave in both directions on the posterior portion. It is confluent on both sides, with the lateral facets for the second metacarpal on the internal side, and for the unciform on the external side, both these lateral facets being small and elongated. There is again an elongate, anteriorly concave, and posteriorly convex facet for the fourth metacarpal placed immediately below the articular facet for the unciform. There is a convex articular facet for the phalanx on the distal end of the bone.

The fourth metacarpal is a little smaller than the third. Its proximal epiphysis is narrower posteriorly, almost triangular in outline, with three articular facets: the upper one, anteroposteriorly convex, for the unciform; the latero-internal one, anteriorly flat and posteriorly convex, for the third metacarpal; and the latero-external one, slightly concave and elongated anteroposteriorly, for the fifth metacarpal. The distal articular facet for the first phalanx is quite convex.

The fifth metacarpal is well developed, a little smaller and wider than the fourth, and also more nodose. The proximal end bears two confluent articular facets, both elongated and a little convex anteroposteriorly, the

TABLE 12

MEASUREMENTS (IN MILLIMETERS) OF METACARPALS I TO V OF THE HOLOTYPE OF *Carodnia vieirai*, NEW SPECIES (D.G.M. No. 333-M)

(Measurements of a referred specimen, D.G.M. No. 336-M, are given in parentheses.)

	I	II	III	IV	V
Length	51 (42.5)	85 (75.6)	94 (83)	88.5 (76.5)	75 (63)
Transverse diameter of proximal end	27 (24)	31 (27.8)	34.5 (33)	34.5 (27.5)	37.2 (32.5)
Anteroposterior diameter of proximal end	23 (21)	33.2 (28.5)	37.2 (34)	38.5 (31)	38 (27.7)
Transverse diameter of diaphysis	18.7 (17.8)	33.5 (29.7)	29 (23.7)	30 (26.5)	29.3 (27)
Anteroposterior diameter of diaphysis	13 (12)	13.7 (12.8)	17 (14)	17.2 (14.2)	15.2 (14.8)
Transverse diameter of distal end	24.5 (24)	41.5 (33.5)	42.7 (33)	40 (33.8)	34.3 (33.2)
Anteroposterior diameter of distal end	18 (14)	28 (26)	29 (26)	31 (24.6)	27 (24.2)

TABLE 13

MEASUREMENTS (IN MILLIMETERS) OF THE PHALANGES OF THE MANUS OF THE HOLOTYPE OF *Carodnia vieirai*, NEW SPECIES (D.G.M. No. 333-M)

(Measurements of a referred specimen, D.G.M. No. 336-M, are given in parentheses.)

	Length	Width
Phalanx I, digit I	27.5 (—)	25.9 (—)
Phalanx I, digit II	34.5 (29.3)	36 (30)
Phalanx I, digit III	40.2 (34.7)	32 (31.5)
Phalanx I, digit IV	35.5 (27.5)	37 (30.5)
Phalanx I, digit V	34.5 (29)	35 (27)
Phalanx II, digit II	26.5 (—)	35 (—)
Phalanx II, digit III	28 (23)	36.5 (29)
Phalanx II, digit IV	25.5 (22)	32 (23.5)
Phalanx II, digit V	26.5 (22)	35.2 (29)
Phalanx III, digit I	19.2 (—)	19.2 (—)
Phalanx III, digit II	— (27)	— (27)
Phalanx III, digit III	38 (27.5)	39 (25)
Phalanx III, digit IV	34.5 (—)	36.5 (—)
Phalanx III, digit V	30.8 (—)	35 (—)

upper one for articulation with the unciform, and the second one, placed on the upper border of the internal side of the bone, for articulation with the fourth metacarpal. The distal end has a convex articular facet for the first phalanx.

The metacarpals have two shallow, lateral, longitudinal, parallel grooves, separated by a weak intermediate ridge, below the distal epiphysis and confluent with the rounded articular surface for the first phalanx. These grooves are for a pair of crescentic sesamoid bones.

The phalanges are robust, but very short, and compressed vertically. The proximal phalanges (I) are the largest. The proximal articular facet for the metacarpal is transversely elongated, nearly ellipsoidal in outline, slightly concave in both directions, and without a central ridge. The distal end is convex, rounded in outline, and slightly depressed on the midline. The median phalanges (II) are shorter than the first ones. Their proximal articular facets are transversely elongated, vertically concave, and slightly convex transversely, with their upper borders quite convex on the midline. The posterior end is convex, with a shallow, longitudinal, median groove. The distal or ungual phalanges (III) are flat, larger than the median ones, with the upper and lower surfaces very rugose, and meeting anteriorly and laterally in a sharp, corrugated edge. The proximal end has a transversely elongated articular facet, divided into concave lateral halves by a weak, smooth, intermediate ridge, which coincides with the intermediate shallow groove of the distal end of the median phalanges.

THE HIND LIMB: Only a right tibia and a left astragalus are preserved (D.G.M. No. 336-M).

The tibia is relatively short and slender. The proximal articular facets for the femur rise to the midline, where they are separated by a narrow, shallow, longitudinal groove. The outer facet is larger than the inner, approximately round in outline, concave in both directions, deeper transversely. The inner facet is more elongated anteroposteriorly, but narrower than the outer one. It is concave in both directions, deeper transversely. A small, flattened facet for articulation with the fibula is present under the outer and posterior part of the outer articular facet for the femur. The cnemial crest of the tibia, for attachment of the ligament of the patella, is very strong and nodose. The anterior face of the diaphysis is rounded, but the posterior is flattened. The articular surface for the astragalus is concave anteroposteriorly and divided into two lateral

TABLE 14

MEASUREMENTS (IN MILLIMETERS) OF THE TIBIA AND ASTRAGALUS OF A REFERRED SPECIMEN (D.G.M. No. 336-M) OF *Carodnia vieirai*, NEW SPECIES

Tibia	
Length	237
Width of proximal epiphysis	82
Anteroposterior diameter of proximal epiphysis	86
Width of diaphysis	29
Anteroposterior diameter of diaphysis	12.8
Width of distal epiphysis	51
Anteroposterior diameter of distal epiphysis	41
Astragalus	
Length	52.5
Width	52.8
Vertical diameter	36.8
Anteroposterior diameter of articular facet for tibia	36.3
Transverse diameter of articular facet for tibia	36.5

parts by a very weak and smooth median ridge, its inner part larger than the outer, in both directions. There is a small, weak, and flattened articular facet for the fibula on the outer margin of the distal epiphysis.

The astragalus is very short and flattened. Its upper face, for articulation with the tibia, is approximately quadrangular in outline, but anteroposteriorly convex and a little concave transversely. It is slightly longer anteroposteriorly on its outer border, which is confluent with the supero-external articular facet for the fibula; the latter is smooth and doubly convex. The anterior part of the astragalus has two articular facets. The inner facet is convex anteroposteriorly and little concave transversely, much larger than the outer one. It is the articular facet for the navicular, while the small, flattened outer facet is for articulation with the cuboid, a feature similar to that found in the Dinocerata. On the inner side of the astragalus is a large, rounded, vertical groove. The inferior surface of the bone is marked by the presence of two well-developed articular facets for the calcaneum, longitudinally separated by a deep, but narrow intermediate groove. The outer inferior facet (ectal) is slightly concave anteroposteriorly, becoming abruptly narrower anteriorly. The inner inferior facet (sustentacular) is much smaller and more concave than the outer and becomes progressively narrower towards the posterior end. The sustentacular facet is confluent anteriorly with the navicular facet, and the ectal is confluent with the cuboidal facet, more or less at right angles.

MEASUREMENTS: The principal measurements of the described teeth and skeletal elements are given in tables 5 to 14.

AFFINITIES

Carodnia is so distinct from all the known groups of ungulates that a detailed comparative study is not necessary to disclose its affinities.

It is true that it would be difficult to separate it from the Pyrotheria on the basis of the molars alone, especially M_{1-2}^{1-2}, which are bilophodont, as are those of the genera of this South American Eocene-Oligocene order. This was the reason why Simpson (1945, p. 132) classified this genus, with doubt, among the Pyrotheria, until then the only known native South American ungulates with bilophodont molars. But on the basis of the much more complete specimens collected in Brazil I can now say that the bilophodont type of molar is the only feature common to *Carodnia* and the Pyrotheria, and that the differences between these two groups in the rest of the dentition and in the known parts of the skeleton are so great that it is unnecessary to make detailed comparisons between them to prove that *Carodnia* cannot belong to the Pyrotheria. It is enough for this purpose to review the diagnoses of these two groups.

Bilophodont molars have developed independently in a number of mammalian orders (Marsupialia, Pantodonta, Pyrotheria, Proboscidea, Sirenia, Perissodactyla, and Artiodactyla, at least), and this character alone does not necessarily indicate phylogenetic relationship. The dentition of *Carodnia* as a whole and particularly its antemolar teeth seem to exclude pertinence to any previous named order in which bilophodont molars occur. Such parts of the skeleton as are known are also distinctive and tend to confirm separation from previous recognized orders. Proposal of a new order, Xenungulata, for *Carodnia* therefore seems to be justified.

The only other genus now known that may eventually prove to belong to the Xenungulata is *Carolozittelia* Ameghino, 1901, from the Casamayoran of Patagonia. This genus is known from molars only. These teeth are bilophodont and could represent an ancestral condition for the later pyrotheres, the only bilophodont group previously known from South America. Ameghino's belief in the relationship of *Carolozittelia* to *Pyrotherium* has therefore been followed by subsequent authors, but the discovery of another, quite distinct bilophodont order in the early Cenozoic of South America casts doubt on this ascription. As far as the scanty evidence of its molars alone is concerned, *Carolozittelia* could belong either to the Pyrotheria or to the Xenungulata. M^{2-3} of *Carolozittelia* are closely similar to M^{1-2} of *Carodnia*, and M_1 or M_2 of *Carolozittelia* similarly resembles M_1 of *Carodnia*. On the other hand M_3^3 are markedly different in the two genera. If *Carolozittelia* should prove to belong in the Xenungulata, it would have to be placed in a distinct family or subfamily. Present evidence, however, does not suffice to show whether *Carolozittelia* is a pyrothere, a xenungulate, or a member of some other bilophodont group.

It is plausible to believe that the Xenungulata arose directly from some branch of the Condylarthra shortly after the arrival in South America of herds of primitive ungulates from North America. The Xenungulata apparently represent a line independent from the Pyrotheria, Astrapotheria, Notoungulata, and Litopterna, which also seem to have been independently differentiated in South America from various groups of Condylarthra.

As mentioned above, *Carodnia* resembles *Uintatherium* in several of its features. The similarities between these two lower Tertiary genera, one from the South American Paleocene, the other from the North American Eocene, and the fact that both the Xenungulata and the Dinocerata are distinguished among contemporary groups of mammals by their much larger size, make plausible the hypothesis that these two groups are more or less closely related to each other. They may constitute collateral, phylogenetic lines, emerging side by side from a common ancestral stock which may have been one of the primitive groups of the condylarthran stock from the North American lower Paleocene or perhaps Cretaceous.

ORDER ASTRAPOTHERIA LYDEKKER, 1894

SUBORDER TRIGONOSTYLOPOIDEA SIMPSON, 1934

FAMILY TRIGONOSTYLOPIDAE AMEGHINO, 1901

TRIGONOSTYLOPS AMEGHINO, 1897

The genotype of this genus is *T. wortmani* Ameghino, 1897, established on a few isolated teeth (left P^4, right $M^{1?2}$, incomplete right M_3, and a tooth which was considered by Ameghino, doubtfully, as a lower C, but which seems to the present author to be an incisor of another genus), all from the Casamayor formation (lower Eocene) of Patagonia, south of Lake Colhué-Huapí.

A great series of other very doubtful species were proposed by Ameghino, on the basis of isolated teeth and fragmentary specimens, all from the same locality and age as the type specimens of *T. wortmani*. The latter seems, however, to be the only one of all the species of *Trigonostylops* proposed by this paleontologist to be well established and determinable, and for this reason it is the only one to be considered in the comparative study of the Itaboraian species.

Perhaps *Trigonostylops gegenbauri* Roth and one or more of the other specific names proposed by Ameghino represent good species, but the available specimens are not enough to decide this question.

At all events, the Itaboraian species is

established on specimens which undoubtedly present more primitive and less specialized features than the Patagonian ones, making it a well-defined species.

Simpson (1933) described an almost complete skull with the right P^{2-4}, M^{1-3}, and the left P^{2-4}, M^{1-2} present, and a partial mandible with the left C, $P_{1,3-4}$, M_1, and the right P_{2-4}, M_{1-3} present, both referred to *Trigonostylops wortmani*. This is the most complete description of the type species of *Trigonostylops* ever given.

Trigonostylops apthomasi Price and Paula Couto, 1950

Plates 38, 39; plate 40, figures 1–3; plate 41, figures 1–3; plate 42, figures 1–4; plate 43; text figure 3

Trigonostylops apthomasi PRICE AND PAULA COUTO, 1950, pp. 162–163.

HOLOTYPE: D.G.M. No. 154-M. Incomplete right $M^{?1}$. Collector unknown, 1945.

PARATYPES: D.G.M. No. 156-M, ectoloph of a right upper molar; No. 155-M, two left lower molars; collector unknown, 1945.

REFERRED SPECIMENS: D.G.M. No. 355-M, crushed partial skull with incomplete right and left C, and P^{2-4}, M^{1-3} present, accompanied by a crushed and incomplete mandible with the alveoli of both I_1 and I_3, the root of the left I_2, and the right I_2, somewhat broken, C, P_{2-4}, and M_{1-3}, incomplete left C, and left P_4, M_{1-3} present; No. 309-M, almost complete mandible with right and left C, right P_1, and right and left P_{2-4}, M_{1-3} present; No. 216-M, fragment of left upper jaw with alveoli of C, P^{1-3}; No. 234-M, partial right lower jaw with P_4, M_{1-3} present; No. 263-M, almost complete right lower jaw of a very young individual with DM_{2-4} and M_1 in use and C and P_1 still enclosed in their alveoli; No. 287-M, partial left upper jaw with M_{1-2} present. M.N.R.J. No. 1498-V, fragment of left lower jaw with M_{2-3} and the posterior part of M_1 present; No. 1499-V, partial left lower jaw with M_{1-3} present; No. 1501-V, right upper C; No. 1599-V, right P^2; No. 1602-V, right P^3; No. 1610-V, right P^4; No. 1616-V, right M^1; No. 1632-V, right M^2; No. 1655-V, right M_3; No. 1824-V, left P_{3-4}, M_2; No. 1827-V, partial left lower jaw with P_4–M_1; No. 1828-V, partial left lower jaw with P_{3-4}, M_1 present; Nos. 1829-V, 1830-V, partial upper jaws with fragmentary M^{1-2} and complete M^3. A.M.N.H. No. 49832, 14 right incomplete lower C; No. 49833, 21 left incomplete lower C; No. 49834, right and left M_2, unassociated; No. 49835, right P_4; No. 49836, two left M^{2-3}, unassociated; No. 49837, series of unassociated left P_1–M_3; No. 49838, series of unassociated right P^3–M^3; No. 49839, series of unassociated left P^3–M^3.

The specimens preceded by the abbreviation D.G.M. were collected by Júlio da Silva Carvalho, 1949, and those designated with the abbreviations M.N.R.J. and A.M.N.H. were collected by Carlos de Paula Couto, 1948–1949.

DIAGNOSIS: Smaller and more primitive species than the Casamayoran ones. Upper C strongly developed, gently curved, and sharp pointed. P^1 (alveolus) and P_1 small, single- or double-rooted (in this case the two roots confluent), and apparently non-functional; the P^1 placed immediately behind the C, and separated from the P^2 by a small diastema; the P_1 separated from the C by a diastema twice as large as that which separates it from the P_2. P^{2-3} as in *T. wortamni*. P^4 transversely elongated, much wider than long, but structurally similar to P^3. M^{1-3} less triangular than in *T. wortmani*, approaching the quadrangular shape; hypocone strong, conical, and as high as the protocone on M^1, conical and much smaller than the protocone on M^2, absent or only vestigial on M^3; metaloph present on M^{1-2}, short, running from the hypocone to the metacone, absent on M^3, on which a very small but definite accessory cuspule, resembling an isolated metaconule, is sometimes present, near the internal base of the metacone; trigon basin open between the protocone and the hypocone on M^{1-2}, and widely open posteriorly on M^3; strong anterior and posterior cingula, the former running down from the anterior base of protocone to the base of the parastyle, and the latter running down from the base of the hypocone to the base of the metastyle; external cingulum weak or absent (sometimes present and with a strong style, between the paracone and the metacone); no cingulum across hypocone. Three pairs of simple lower incisors. Lower C strong but relatively short, sharp pointed, somewhat cutting. Lower cheek teeth as in *T. wortmani*, but

P_{3-4} simpler, P_4 much less molariform. The symphyseal region high, strong, laterally compressed, with a depression and a vestigial lower flange on its lateral side, immediately behind the canine, to lodge the upper tusk.

DESCRIPTION: It seems that the dental formula was complete,

$$\frac{3.1.4.3}{3.1.4.3}$$

although nothing is known about the upper incisors, their presence being deduced from the presence of the lower ones, as shown in D.G.M. No. 355-M, in which the alveoli of the right and left I_1 are present, the interseptum being broken. I_1 was certainly thin, probably much smaller than I_2, and destined to disappear. The right I_2 is present, but with the crown broken; it is relatively well developed, but small, and somewhat laterally compressed. I_3 (alveolus) seems to have been similar to I_2, in size and in form. The lower canines are strong, sharply pointed, somewhat cutting, and twisted outwardly; the posterior face of the crown presents a large, longitudinal wear facet, produced by contact with the anterior face of the upper C. When unworn, the crown is completely covered by a thin and smooth coat of enamel. The root extends backward probably to the posterior end of the symphysis; it is oval in transverse section and almost completely occupies the internal part of the symphyseal region, side by side with the root of the opposite homologous tooth.

The upper C is enormous, more or less oval in transverse section, sharply pointed, gently curved, directed forward and somewhat laterally. The crown is covered by a thin and smooth coat of enamel. When worn, the anterior face of the crown presents a large and slightly convex wear facet which forms an angle of nearly 120 degrees with the anterior face of the root. The root is very long, closed, and reaches the upper part of the maxilla, where it forms a rounded boss.

P^1 (alveolus) is small and apparently nonfunctional, single-rooted (or two-rooted, but with the two roots confluent), laterally compressed, and placed immediately behind the canine. There is a short diastema between it and the P^2.

P^{2-4} are contiguous. P^2 is small, longer than wide, with a main mesial cutting cusp, an accessory and a vestigial posterior cuspule, and a short, rounded, internal, basal projection, which presents a smooth surface. P^3 is triangular in outline, slightly wider than long. The paracone is the predominant cusp of the ectoloph, and the metacone is smaller and confluent with the paracone. There are a strong parastyle, much smaller than the paracone, and a less strong metastyle, the former being separated from the paracone by a deep vertical fold. The protocone occupies the whole inner side of the tooth; it is crescentic and connected with the base of the parastyle and metastyle by two divergent ridges, the protoloph and the metaloph, the former sharper and higher than the latter, which is rounded and more rapidly worn down. There are weak anterior, posterior, and external cingula, but no cingulum across the protocone. P^4 is structurally similar to P^3, but anteroposteriorly compressed and much wider than long.

The upper molars are roughly triangular in outline, tending towards quadrangular. They are wider than long. The ectoloph is much more elongate than that of the premolars. The paracone and metacone are the highest cusps of the trigon and of nearly the same size, or the metacone is slightly higher. The protocone is conical, strong, but not so high as the external cusps. It is connected with the middle part of the parastylar fold by a low and sharp protoloph. The hypocone is strong, conical, as high and well developed as the protocone in M^1, smaller than the protocone in M^2, absent or vestigial in M^3. On M^{1-2} a low, sharp, and short ridge runs from the hypocone to the base of the metacone. The parastyle and metastyle are low, the former more definite than the latter. The parastylar fold is more or less strong, and the metastylar fold very weak. A strong anterior cingulum runs down from the antero-internal part of the base of the hypocone to that of the parastyle, and a posterior cingulum runs down from the hypocone to the base of the metastyle. The external cingulum is weak or absent, and there is no cingulum across the hypocone. The trigon basin is broad and opens on the lingual side by means of a deep notch between the protocone and the hypocone, in M^{1-2}. It is large and widely open

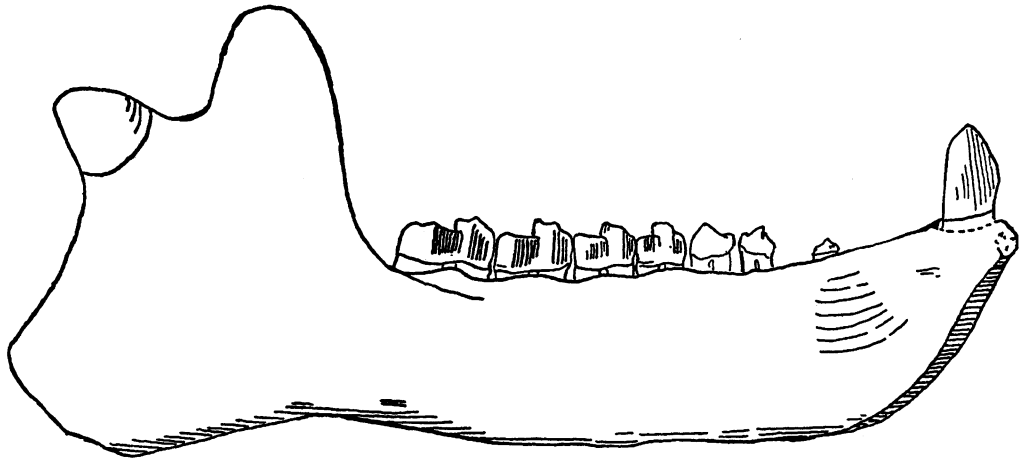


FIG. 3. *Trigonostylops apthomasi* Price and Paula Couto, 1950. D.G.M. No. 309-M. Mandible, right external side view. ×4/5.

to the posterior cingulum in M^3.

In the mandible, the canines are singularly placed in a very anterior position, almost at the anterior end of the jaw. Anterior to them there is only a short forward prolongation of the symphyseal region, which supports three pairs of small incisors.

P_1 is very small, apparently non-functional, longer than wide, single-rooted, with a low mesial main cusp and a vestigial posterior heel. It is placed on the diastema between the canine and P_2, but is twice as far from the canine as from P_2 (specimen D.G.M. No. 309-M).

P_2 is smaller than P_3, longer than wide, with a well-developed mesial main cusp, followed by a basal, conical one, placed on the middle part of the posterior end of the small talonid.

P_3 is intermediate in size between P_2 and P_4, tending to become molariform. Its main cusp is the protoconid, from which a short and obliquely descending crest runs to the smaller, rather indefinite metaconid, which is immediately postero-internal to the protoconid. Another crest runs down from the apex of the protoconid to the middle part of the anterior face of the tooth. The talonid is shorter but wider than the trigonid and has a basal, but well-developed and slightly crescentic hypoconid.

P_4 is somewhat molariform. Its trigonid is better developed than that of P_3, and has a strong metaconid, which is a little lower than the protoconid and immediately postero-internal to it. The metaconid is connected with the protoconid by an oblique crest, which is longer than the homologous element on P_3. The talonid is as long as but wider than the trigonid. The hypoconid is twice as long as and more crescentic than that of P_3. There is a postero-internal and transversely elongated basal cusp (entoconid?), followed by a short and weak cingulum.

The lower molars are similar in structure, but M_{1-3} are progressively larger, M_1 being somewhat longer and wider than P_4. The two principal elements of the well-defined trigonid are the protoconid and the metaconid, of nearly the same size, the latter a little postero-internal to the former and connected with it by a high, sharp, obliquely transverse crest, slightly concave anteriorly. Another crescentic crest slopes abruptly from the apex of the protoconid to a basal cusp (probably the vestigial paraconid) on the middle part of the anterior face of the molar. The talonid is longer and wider but lower than the trigonid; its external side is occupied by the large, crescentic hypoconid, the posterior end of which is directed to the small postero-mesial hypoconulid. A well-defined entoconid is present on the postero-internal angle of the talonid; it is conical on M_{1-2} and transversely compressed on M_3. The entoconid is slightly anterior to the hypoconulid, to which it is

connected by a short crest, slightly arched downward. The talonid basin is wide, especially on M_3, and widely open on its internal side between the metaconid and the entoconid. There are short and weak anterior and posterior cingula. The external cingulum is weak and sometimes absent. There is no internal cingulum.

The only known skull (D.G.M. No. 355-M) is too badly crushed and broken for an accurate description to be made. All the part anterior to the canines and all the posterior portion are lacking. The facial part of the maxilla has a very prominent, rounded, and smooth swelling lateral to the large root of the canine and resulting from the enormous development of this root, which reaches even the upper part of the maxilla, as shown by a small, smooth swelling at this point. A pronounced hollow is located between the conspicuous facial swelling and the anterior part of the base of the zygomatic process. A large preorbital foramen is present on the posterior end of this hollow, just over P^{2-3} (D.G.M. No. 216-M). It seems that the zygomatic root extends from over the anterior part of M^2 to over the middle part of M^3. The supraorbital process is strong but short, subtetragonal, indicating that the orbit was widely open to the temporal fossa; it is followed, on the upper part of the skull, by the well-defined but weak, anteriorly convex, antero-lateral branch of the sagittal crest.

The mandible has a strong, elongate, deep, and laterally compressed symphyseal region, the upper part of which is grooved and limited by sharp lateral ridges, placed just on the dental border. On the lateral face of the symphyseal region are a pronounced hollow and a vestigial lower flange to lodge the large upper tusk when the mouth was closed. The enlargement of the symphyseal region is a result of the unusual development of the roots of the lower canines, which, implanted side by side, occupy most of its interior, extending back almost to the posterior end of the symphysis, which ends under the anterior border of P_2. An anterior mental foramen, directed downward, is present under the middle part of the diastema between C and P_2, and another smaller foramen is seen under P_3. Both foramina are a little closer to the alveolar border than to the lower border of the mandible. Several other small vascular foramina are present on the antero-inferior and on the lateral faces of the symphyseal region, indicating, perhaps, that this region was covered by a heavy mass of soft tissue. The horizontal ramus appears normal, but its lower border, which is straight and parallel to the dental or alveolar border to a point under M_2, rises abruptly below M_3 and slants down near the angular region, which is flat and much prolonged and rounded posteriorly. The coronoid process is high and slender. The condyle is wide transversely and is situated at a level well above that of the teeth. The masseteric fossa is broad and quite pronounced. The posterior opening of the dental canal is large and placed a little above the level of the teeth.

Among the specimens referred to this species is a right lower jaw of a very young individual with DM_{2-4} and M_1 in use (D.G.M. No. 263-M).

These milk teeth present special features, so must be described. The DM_2 is so compressed laterally as to be almost laminar and is almost three times longer than wide. It has a mesial and laterally compressed main cusp, preceded by a small but definite, basal, anterior cuspule, and followed by a wider heel, which is limited externally by a well-developed and laterally compressed basal cuspule. DM_3 is much longer than wide and is a little longer but considerably wider than DM_2. It is much more molariform than P_3 and differs from the true molars only by its much smaller size and by its somewhat laterally compressed trigonid. DM_4 is also more molariform than P_4. It is slightly longer and considerably larger than DM_3 but much smaller than M_1, from which it differs, morphologically, only by its relatively narrower trigonid. The talonid of DM_{3-4} does not differ in any way from that of the true molars. P_1 of this specimen was erupting. It is two-rooted. The upper part of its crown appears above the alveolus and has a well-developed main cusp, laterally compressed, and a posterior heel with two small cusps, the anterior of which is placed immediately behind the main cusp, from which it is separated by a sharp notch. The posterior cusp of the heel is placed at the posterior end of the crown,

TABLE 15

MEASUREMENTS (IN MILLIMETERS) OF THE UPPER CHEEK TEETH OF *Trigonostylops apthomasi* PRICE AND PAULA COUTO

	P^2		P^3		P^4		M^1		M^2		M^3	
	L	W	L	W	L	W	L	W	L	W	L	W
Holotype, D.G.M. No. 154-M	—	—	—	—	—	—	9.8	11[a]	—	—	—	—
D.G.M. No. 355-M	6.6	4.3	7	8.2	7	10.5	10	11.9	12	13.8	11.2	14
D.G.M. No. 287-M	—	—	—	—	—	—	9.2	10.5	11	13	—	—
M.N.R.J. No. 1830-V	—	—	—	—	—	—	—	—	12	13.8	12	15.2
M.N.R.J. No. 1829-V	—	—	—	—	—	—	—	—	12[a]	13[a]	11	13.2
M.N.R.J. No. 1599-V	6.3	4.3	—	—	—	—	—	—	—	—	—	—
M.N.R.J. No. 1602-V	—	—	6.5	7.5	—	—	—	—	—	—	—	—
M.N.R.J. No. 1610-V	—	—	—	—	7.2	10.9	—	—	—	—	—	—
M.N.R.J. No. 1616-V	—	—	—	—	—	—	10.2	12.8	—	—	—	—
M.N.R.J. No. 1632-V	—	—	—	—	—	—	—	—	12	13.3	—	—
M.N.R.J. No. 1655-V	—	—	—	—	—	—	—	—	—	—	12.8	15.8

[a] Approximate.

postero-internal to the first heel cusp, to which it is connected by a short, ascending crest. By making an opening on the sutural surface of the symphysis, the unerupted canine could be examined. Its crown is short, laterally compressed, and bluntly pointed, covered with a thin coat of smooth enamel. Its root is again shorter than the crown, with the pulp cavity open (it is closed in the adult canine). The symphysis was not fused in young individuals.

Measurements of the type specimens and of some of the referred ones are given in tables 15 to 17.

Trigonostylops sp.

Among the teeth collected in São José de Itaborai there are four lower canines, four upper molars, and one lower molar, which are so much smaller than the corresponding ones of *Trigonostylops apthomasi* that it seems better to separate them for the present. If additional and more complete material is collected, it may be possible to decide if they represent a different species or are merely pygmy individuals of *T. apthomasi*, as is possible since there is wide variation in size and in proportions among the specimens referred to this species.

These smaller specimens are:

M.N.R.J. No. 1832-V, incomplete right lower C
M.N.R.J. No. 1833-V, incomplete left lower C
M.N.R.J. No. 1834-V, incomplete left lower C
M.N.R.J. No. 1835-V, incomplete right lower C
M.N.R.J. No. 1598-V, left M^3
M.N.R.J. No. 1836-V, left M^3
M.N.R.J. No. 1837-V, right $M^{?1}$
M.N.R.J. No. 1838-V, right $M^{?1}$
M.N.R.J. No. 1839-V, right M_3

TABLE 16

MEASUREMENTS (IN MILLIMETERS) OF THE LOWER CHEEK TEETH OF *Trigonostylops aphomasi* PRICE AND PAULA COUTO

	P_1		P_2		P_3		P_4		M_1		M_2		M_3	
	L	W	L	W	L	W	L	W	L	W	L	W	L	W
Paratype, D.G.M. No. 155-M	—	—	—	—	—	—	9.8	6.7	10	6.4	—	—	—	—
D.G.M. No. 355-M	—	—	—	—	7.2	4.7	7.3	5.6	9.4	6.1	—	—	—	—
D.G.M. No. 309-M	4.3	3.1	6.3	4.1	7.6	5.3	8.2	6.5	9.8	6.6	11.9	8	15.4	8
D.G.M. No. 234-M	—	—	—	—	—	—	7.8	5.1	9	5.7	10.6	6.7	13.9	7.4
M.N.R.J. No. 1499-V	—	—	—	—	—	—	—	—	9.8	6.4	11.8	7.4	13.9	7.3
M.N.R.J. No. 1498-V	—	—	—	—	—	—	—	—	—	—	11	7.3	13.5	7.3
M.N.R.J. No. 1828-V	—	—	—	—	7.7	5.2	7.7	5.2	8.3	5.5	—	—	—	—
M.N.R.J. No. 1824-V	—	—	—	—	7.7	4.8	7.8	5.6	—	—	10.2	7.3	—	—
M.N.R.J. No. 1827-V	—	—	—	—	—	—	7.9	5.2	9.3	6	—	—	—	—

TABLE 17

MEASUREMENTS (IN MILLIMETERS) OF THE MANDIBLE OF *Trigonostylops aphtomasi* PRICE AND PAULA COUTO (D.G.M. NO. 309-M)

Length, from anterior border of symphysis to middle of posterior border of angular region	163.5[a]
Length, from anterior border of symphysis to middle of posterior border of condyle	145[a]
Distance between middle of posterior border of angular region and posterior angle of coronoid process	63.8
Height of posterior part of mandible, from upper border of coronoid process to lower border of mandible, on a line passing anterior border of posterior opening of dental canal	65
Height of mandible below middle of M_1	28.2
Height of mandible at posterior end of symphysis	29.3
Distance between postero-mesial part of condyles	63.3
Thickness of mandible under mesial part of M_1	14.4
Thickness of mandible at level of posterior end of symphysis	14
Width of condyle	22.8
Coronoid angle (at intersection of line between anterior border of symphysis and mesial part of posterior border of angular region and line passing by anterior border of coronoid process)	90°
Mandibular angle (at intersection between lines from anterior border of symphysis to postero-mesial part of M_3)	22°

[a] Approximate.

Structurally, the lower C, $M_{?1}$, M^3, and M_3 are not different from the homologous teeth of *Trigonostylops apthomasi*, except in the fact that in the M^3 the strong anterior and posterior cingula meet under the middle part of the internal base of the protocone, and the posterior cingulum is not elevated at its internal end to form a vestigial hypocone, as is sometimes seen on M^3 of *T. apthomasi*.

The measurements of the cheek teeth are given in table 18.

TABLE 18

MEASUREMENTS (IN MILLIMETERS) OF ISOLATED UPPER AND LOWER MOLARS OF *Trigonostylops* SP.

	Length	Width
$M_{?1}$, M.N.R.J. No. 1837-V	7.9	9
M^3, M.N.R.J. No. 1598-V	9	10.5
M^3, M.N.R.J. No. 1836-V	9	10
M_3, M.N.R.J. No. 1839-V	11.8	6.2

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