V. On Remains of a large extinct Lama (Palauchenia magna, Ow.) from Quaternary Deposits in the Valley of Mexico. By Professor Owen, F.R.S. &c.

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In the second of Dr. Lund's communications to the Danish Academy of Sciences, entitled "Survey of the extinct species of Mammalia which inhabited the Highlands of tropical Brazil previously to the last Geological Revolution," he includes amongst the Ruminantia two kinds of Camelidæ, observing:—"Of the genus Camelus I possess the remains of two species, one exceeding a horse in size, the other a little less. To which of the two subgroups of this genus the fossils belong, that is, whether to the modern inhabitant of the warm regions of the old world, Camelus, Ill., or to that now found in the chain of the Andes, Auchenia, Ill., my insufficient means of comparison will not allow me to decide"\*.

Professor Pictet, in his comprehensive 'Traité de Paléontologie,' refers the fossils so indicated by Lund to the genus *Auchenia*, but without, apparently, any additional facts or evidence to guide him to this decision †.

Professor De Blainville, in the Fasciculus of his 'Ostéographie' relating to the genus Camelus, remarks:—

"Parmi les pièces fossiles déjà assez nombreuses provenant du Brésil, que nous possédons dans les collections du Muséum, je n'en ai encore rencontré aucune qui puisse être rapportée aux Lamas, et je ne vois pas que dans ses Mémoires, publiés dans les 'Actes de l'Académie Royale des Sciences de Copenhague,' M. Lund ait fait connaître, soit par des descriptions, soit par des figures, les pièces qui ont servi de base à ces assertions; elles n'en ont pas moins été reprises cependant dans toutes les compilations paléontologiques" (p. 123).

I may remark that M. Lund does not commit himself to any assertion of the particular genus of *Camelidæ* to which his fossils belonged, whatever parts he might have obtained from the caves at the date of the Memoir above alluded to.

In his later communication to the Danish Academy, of November 1844, published in the twelfth volume of the Transactions above quoted, there appears in the list, p. 86, "No. 12, *Auchenia*;" but all that is subsequently added upon this subject is as follows:—

- \* Det Kongelige Danske Videnskabernes Selskabs Naturvidens. og Mathem. Afhandlinger, 1838. (Translated and published in the 'Magazine of Natural History,' by the Rev. W. Bilton, M.A., 1840, New Series, p. 1.)
- + "Les Lamas (Auchenia, Ill.) paraissent avoir habité l'Amérique méridionale pendant l'époque diluvienne, comme de nos jours. M. Lund en a trouvé deux espèces dans les cavernes du Brésil; l'un d'elles surpassait le cheval par sa taille."—8vo Ed. 1853, tome i. p. 345.

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"The remains of this genus were most numerous in this Cavern ('Lapa d'Anna Felicia'), and showed evidences of six individuals, mostly young animals"\*.

Professor Gervais, in the Anatomical Part or Appendix to Count Castelnau's Expedition to the central parts of South America†, refers to the genus Auchenia some fossil bones of the feet found by Mr. Weddell in deposits at Tarija, in Bolivia, associated with Mastodon and other extinct species. They exceeded in size those of the largest Lama (Auchenia lama), being intermediate in size between that and the Camel. M. Gervais observes that it may be, perhaps, the species said by Lund "to exceed a horse in size"; he figures the fragmentary fossils as belonging to an Auchenia Weddellii.

More decisive evidences of Auchenia from the deposits at Tarija were afforded by fossil teeth. The first of these is a part of the upper jaw with the four chief molars ("portant encore les quatre paires de molaires principales pour chaque côte," Gervais, ut suprà, p. 41), having a longitudinal extent nearly the same as that in the Lama. (This fossil is not figured, nor are the dimensions of the teeth given.) Next are mentioned portions of mandibles "with the four molars in place." These are figured of half the natural size §.

The longitudinal extent of the series is 85 millims. (=3" 4"), while that in a large Lama in the Museum of Comparative Anatomy in the Jardin des Plantes is 75 millims. (=2" 11").

In a specimen of Auchenia lama before me, the longitudinal extent of the four lower grinders is 3 inches, or 76 millims. The anterior molar (=p4) of the fossil is stronger ('plus forte') than its correspondent in the living Lamas, and its anterior fold is much more marked. These fossils, with an astragalus and calcaneum, are referred to Auchenia Castelnaudii, Gerv.

A fragment of the right ramus of the mandible with the molar m 2 in place and the alveoli of m 1 and p 4, inferior in size to that of Auchenia Castelnaudii, is indicative of an animal less than the domestic Lama but greater than the Vicugna, and it is referred, with a tibia which reproduces that of an Auchenia by its forms  $\parallel$ , to the Auchenia intermedia, Gerv.

To the evidences of extinct *Camelidæ* in the tertiaries and post-tertiaries of North America, for which science is indebted to Professor Leidy, I shall refer in the sequel.

- \* "Levningerne af denne Slægt hörte til de tatrigere i denne Hule og antydede vel sex Individer, hvoraf de fleste unge Dyr."—Op. cit. 12 Deel (1846) p. 89.
- † Expédition dans les parties centrales de l'Amérique du Sud, &c., sous la direction du Comte Francis de Castelnau: 'Anatomie,' par M. Paul Gervais, &c., 4to, 1855, p. 41.
- ‡ "L'animal qui a laissé ces différents ossements était trop supérieur en dimensions aux Lamas actuels pour que l'on suppose qu'il a pu être de la même espèce qu'eux, et il ne me paraît pas douteux que l'examen de nouveaux débris montrera entre eux et lui de nouvelles différences; c'est peut-être cette espèce ou une peu différente par les dimensions que M. Lund a comparé au Cheval. Elle approchait du Chameau sous le même rapport, mais sans être cependant aussi grande, et elle tenait le milieu entre lui et le Paco ou Guanaco."
  - § Op. cit. plate 10. figs. 1 & 2.

<sup>||</sup> Op. cit. p. 43.

Professor Burmeister states that M. Bravard has deposited in the Public Museum of Buenos Ayres part of a mandible with the three posterior molars, which seemed identical with those of *Auchenia intermedia*, Gerv.\* No other fossil evidence of an *Auchenia* had come to Professor Burmeister's knowledge in 1867.

In that year (1867) I was favoured by receiving from Don Antonio del Castillo, Mining Engineer of Mexico, through the kind intermedium of R. T. C. Middleton, Esq., Sec. to Her Majesty's Legation, Mexico, photographs and casts of six of the cervical vertebræ, and photographs of the lower molar series and canines of an Auchenia, much exceeding in size any remains suggesting an animal intermediate between a Lama and a Camel. Without knowing the degree in which the fossil Cameline remains from the Brazilian cavern "exceeded a horse in size," one cannot judge of the difference or resemblance in that character between Lund's fossil and those about to be described; but the probability is in favour of Professor Gervais's estimate, as exemplified in his Auchenia Weddellii. According thereto the extinct species of Lama from Mexico must greatly exceed in size any of which we have had previous indications. The evidences above specified were found by Don Antonio del Castillo, in or beneath volcanic tufa, in the valley of Mexico, associated with remains of Elephas and Mastodon.

Don Antonio del Castillo informs me that "the teeth lay, when exposed, in their natural position; but much of the jaw had crumbled or dissolved away after entombment."

In that position his photographs of the inside view, and of an oblique upper and outside view were taken, and with these I received admeasurements of the several teeth in millimeters.

The teeth consist of the series of grinders, in number five, not four as in *Camelus* and *Auchenia*, also of a minute caniniform premolar rising about halfway in the long diastema between the molar series and the canine; this tooth was likewise present, small, compressed, subrecurved. Of the incisors I have received no information.

Concluding that they existed in the number common to the Camelidae, the dental formula of the mandibular ramus, in the present fossil, would be:—i3, c1, p3, m3 =10 (Plate IV. fig. 3). The series of five molars (ib. figs. 1 & 2) includes p3, p4, m1, m2, m3; the advanced rudimental premolar may be p1, fig.  $3\dagger$ ; then, with a shorter interval, comes the canine, c.

It is rare to find in any Auchenia, still more rare in Camelus, the lower penultimate

<sup>\*</sup> G. Burmeister, M. & Phil. D. Anales del Museo Público de Buenos Aires, 4to (Entrega Quarta), 1867, p. 234.

<sup>†</sup> The decomposed state of the jaw photographed makes the precise position of this rudimental tooth somewhat uncertain; but of its existence in the alveolar part of the long diastema there is no doubt.

<sup>[</sup>I regret that the political troubles in Mexico, followed by the withdrawal of our Legation, and an anarchical condition of the Capital, suspended my relations with the accomplished discoverer of the fossils described in the present paper.—February 1870.]

premolar  $(p\ 3)$  retained after  $m\ 3$  has risen into place. The only example of Auchenia (an A. vicugna) in which I have observed this condition I figured, on that account, in my 'Odontography,' plate 133. fig. 2. The proportions of the retained  $p\ 3$  in the great fossil Lama resemble those in that Auchenia vicugna, but the functional and commonly retained last premolar  $(p\ 4)$  is relatively larger in Palauchenia (compare figs. 3, Palauchenia, and 4, Auchenia vicugna, both reduced to  $\frac{2}{5}$ , nat. size, in Plate IV.).

A caniniform premolar is commonly present in the lower jaw of the Camel and Dromedary in the long diastema between the retained last functional premolar (p4) and the canine: I have not observed such premolar in any Auchenia, nor is any mention of such made by Cuvier or De Blainville  $(op.\ cit.\ p.\ 95)$ . In the lower jaw of an Auchenia vicugna in the British Museum  $(675\ a)$ , there is a small hard tuberosity on the alveolar border, a little way behind the canine, which may indicate the former existence of a rudiment of a premolar (Plate IV. fig. 4, p1,?) answering to that developed in Camelus.

In *Palauchenia* the rudimental caniniform premolar (ib. fig. 3, p 1) seems to be situated as in *Camelus*, but is relatively much smaller than is the caniniform premolar (p 1 or p 2) in that genus.

The penultimate premolar (Plate IV. figs. 1, 2, 3, p 3) is a longish, slender, straight, obtusely pointed cone, rising in contact with p 4, but not attaining the level of the grinding-surface; though small (see Table of Dimensions, p. 69) it is relatively larger than its homologue, the exceptionally developed rudiment, in the Vicugna (ib. fig. 4, p 3), and it may be therefore inferred to have been more constantly developed and present in Palauchenia.

What is more certain is the larger proportional size of the last or functional premolar (ib. ib. p4) in Palauchenia than in Auchenia, the fossil in that respect more resembling Camelus, but with a larger size and difference of form of the tooth in question. In Camelus the fore end of p4 is narrow, the outer surface curving inward to meet the inner one at a ridge which forms the fore part of that surface. In Palauchenia the fore part of p 4 is as thick or broad as the back part, and is flattened,—a modification which adds to the probability of the constancy of p 3 in the grinding-series of Palauchenia. Camelus p 4 has a posterior portion or lobule marked off by an external and an internal longitudinal or vertical groove, and the corresponding part of the grinding-surface shows, after moderate attrition, a distinct small island of enamel. One cannot help recognizing this hind part as the rudimental homologue of the second lobe in the true molars. There is a slight indication of the outer posterior groove in Palauchenia (ib. figs. 1 & 3, p4), but no corresponding inner one, and no distinct posterior islet of enamel. One long slightly curved fold (Plate IV. fig. 1, p4) penetrates the grinding-surface, and the tooth represents, as in Auchenia and the true Ruminants, the half, or a single lobe, of the true molars.

These (Plate IV. figs. 1, 2, 3, m 1-3) adhere to the type in  $Camelid\alpha$ , with minor modifications resembling those in Auchenia. The outer sides of the lobes (ib. figs. 1 & 3) are

not subangular prominences as in Camelus, but are convex as in Auchenia, yet in a markedly minor degree; and, concurrently, the worn edge of parietal enamel is more even, rises less angularly, than in existing Camelida. The small anterior lobule ("filet verticale," Cuvien) is present in the penultimate and last molars, as in Auchenia, but is relatively less, and is indicated only on the outer side of the tooth (ib. fig. 1, m 2, x, and m 3, x). The third or posterior lobule of m 3 (ib. z) is relatively less developed than in either Auchenia or Camelus.

The canine, 1 inch 1 line in length of crown, 6 lines in fore-and-aft breadth, is compressed, recurved, and retains more of the shape and proportions of that tooth in *Auchenia* than in *Camelus*.

The following are dimensions of the series of grinders and of the individual teeth of Palauchenia magna:—

Teeth, Lower jaw.	Palauchenia.	Camel.	Lama.
Length of series of $p 3-m 3$ . $p 3$ . Antero-posterior breadth of base. $p 4$ . Antero-posterior breadth *  Transverse breadth *  Length of crown † $m 1$ . Antero-posterior breadth †  Transverse breadth  Length of crown ‡ $m 2$ . Antero-posterior breadth  Transverse breadth  Length of crown † $m 3$ . Antero-posterior breadth  Transverse breadth  Length of crown $m 3$ . Antero-posterior breadth  Transverse breadth	m. in. lines, $0.168=6$ 7 $0.007=0$ 3 $0.029=1$ $1\frac{1}{2}$ $0.023=0$ 11 $0.034=1$ 4 $0.039=1$ 6 $0.024=0$ $11\frac{1}{2}$ $0.034=1$ 4 $0.045=1$ 9 $0.024=0$ $11\frac{1}{2}$ $0.035=1$ $4\frac{1}{2}$ $0.035=1$ $4\frac{1}{2}$ $0.048=1$ $10\frac{1}{2}$ $0.048=1$ $10\frac{1}{2}$ $0.024=0$ $11\frac{1}{2}$	in. lines. 6 9  1 0 0 7 1 2 1 6 0 9 1 3 1 11 0 9 1 1 4 2 4 0 9	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$
Length of crown	$0.050 = 2$ $0^2$	$\overset{\circ}{1}  \overset{\circ}{5}$	0  7

Cervical Vertebræ. Plates V., VI., VII., and Plate IV. figs. 5 & 6 (reduced view).

With the decayed portions of mandible and the teeth above described were found parts of the skeleton, of which I have been favoured by Don Antonio with plaster-casts and photographs of six vertebræ. They are more or less mutilated, but sufficiently entire to show that they are the six consecutive vertebræ of the neck succeeding the atlas, and of one and the same quadruped (Plate IV. fig. 6, 2 to 7).

These cervical vertebræ present the character of the intraneural vertebrarterial canal characteristic of the *Camelidæ* among existing Ungulates; and, as this character is only known among extinct species in the perissodactyle genus *Macrauchenia*, the field of comparison is restricted, and the results confirm the inference, from juxtaposition of the fossils, that the vertebræ in question belong to the same animal as the teeth above described.

<sup>\*</sup> Across the middle of the grinding-surface.

<sup>†</sup> To the origin of the roots.

<sup>#</sup> Across the middle of the anterior lobe.

An oblique upper view, one-fourth the natural size, of the second to the seventh cervical vertebræ inclusive, coarticulated, is given in Plate IV. fig. 6; an oblique under view of the third and fourth cervicals, coarticulated, is given, similarly reduced, at fig. 5. Figures of three of the more characteristic vertebræ are given, of the natural size, with the answerable ones in *Auchenia* and *Camelus*, in Plates V. & VI., and alone in Plate VII.

The axis vertebra (Plate IV. fig. 6, 2, Plate V. fig. 1) wants the major part of the odontoid process, o, the right diapophysis, the end of the left one (Plate V. fig. 1, d), and the left postzygapophysis (restored in ib. fig. 1, from the right side at z'). This vertebra yields an entire length of 8 inches, the breadth anteriorly is 4 inches, the breadth of the posterior surface of the centrum is 2 inches 5 lines; with the odontoid complete the length of this vertebra would be nearly 9 inches.

The vertebrarterial canal commences within the anterior half of the neural canal, and emerges at the lower and lateral part of the fore end of the centrum within the exit canal (e, e') of the second cervical nerve, near the confluence of the odontoid process; a forward continuation of the almost subsided ridge from the diapophysis (d) divides the nerve-outlet into an upper issue (e) for the dorsal, and a lower issue (e') for the sternal divisions of that nerve, near the latter of which outlets the arterial canal opens, being concealed from outer view by the bony bridge.

Now this is precisely the condition of the nervous and arterial foramina in the vertebra dentata of Auchenia (Plate V. fig. 2, e, e'). In Camelus (ib. fig. 3) the dividing bridge is wanting; the antero-lateral part of the centrum of the second cervical, at its confluence with the odontoid, presents a large longitudinally elliptic depression, e, into the hind part of which opens the vertebrarterial canal, and into the fore part the wider nerve-foramen. The part of the neurapophysis anterior to this is narrower in Camelus, relatively much narrower than in Auchenia, with which in this respect Palauchenia agrees. In the second cervical of *Palauchenia* the hypapophysial ridge commences at the middle of the centrum, gradually deepening backward, and rather abruptly expanding into an obtuse subelongate tuberosity (ib. fig. 1, hy) reaching the posterior articular surface of the centrum. In this character Palauchenia agrees with Auchenia (ib. fig. 2, hy); in Camelus the hypapophysis (ib. fig. 3, hy) expands posteriorly and divides into a pair of tuberosities. The bridge dividing the upper and lower nerve-outlets is continued backwards, in Palauchenia, into the angle dividing the lower lateral from the upper lateral surfaces of the vertebra, and this obtuse ridge or angle is gradually produced outward to form the long but low diapophysis, d. In Camelus the lower border of the elliptic depression (Plate V. fig. 3, e) is produced, sharpened, and continued backward into the diapophysis (ib. d).

The neural spine (n.s.) in *Palauchenia* is a long low ridge, expanding posteriorly into a largish irregularly rough surface, which seems to have been simple or subbifid as in *Auchenia*; it is certainly not so abruptly expanded, nor is it so distinctly bituberculate as in *Camelus* (the contour of the neural spine of which is indicated by the dotted line in fig. 3, to n.s.).

The postzygapophyses are small in Palauchenia (Plate V. fig. 1, z'), showing similar proportions to those in Auchenia (fig. 2, z'); in Camelus (fig. 3, z') they are more abruptly expanded and, as it were, pedunculate. From the outer side of the postzygapophysis a low ridge (fig. 1, r) extends obliquely downward and forward to the fore part of the diapophysis; in Auchenia this ridge is directed toward the upper nerve-outlet (fig. 2, e), and subsides before it attains thereto; in Camelus (fig. 3) the ridge is wanting. The loftier and stronger neural arch and spine of the second cervical in Camelus (fig. 3, n.s.) give it proportions more like those of ordinary Ruminants; in the longer and more slender form of the vertebra Palauchenia resembles Auchenia.

In an old Lama I have seen a pair of sharp longitudinal ridges (fig. 2, s) at the under part of the second cervical centrum, midway between the beginnings of the hypapophysis (hy) and the diapophysis (d); a low ridge on each side the beginning of the hypapophysis indicates the same relation to muscular attachments in Palauchenia: there is no trace of this character in Camelus.

The third cervical vertebra of Palauchenia (Plate IV. figs. 5 & 6, 3, and Plate VI. fig. 1) lacks, accidentally, the hind half of the neural arch with the postzygapophysis and the right pleurapophysis; sufficient, however, remains to well test the degree of its correspondence, respectively, with the same vertebra in Auchenia (Plate VI. fig. 2) and in Camelus (ib. fig. 3). In these existing genera the contrast and conformity respectively with the fossil, in the proportions of the third cervical, are greater than that in the second, the Camel's vertebra assuming more breadth and height in relation to its length. Palauchenia strikingly resembles the Auchenian type in the general shape and proportions of the third cervical. The length of the centrum is 7 inches 3 lines; the vertical dimension at the ends of the pleurapophyses (pl) is 3 inches 8 lines: in Camelus the length of the centrum is 6 inches 9 lines; the vertical dimension at the ends of the pleurapophyses (pl) is 5 inches 6 lines; as this is the place of greatest vertical diameter of the third cervical in both Camel and Lama, the mutilation of the fossil vertebra does not affect the application of this comparative admeasurement. The third cervical of a large Lama (ib. fig. 2) yields 4 inches 6 lines, and 2 inches 3 lines, in the above dimen-· sions.

The fore part of the centrum is convex in *Palauchenia* in the degree it presents in *Auchenia*, and is less convex than in *Camelus*; in each of these the ball does not fit into a corresponding cup at the back of the second cervical centrum, but works in one contributed chiefly by the intervertebral concentric ligamentous substance. In the flatness of the hind surface of the centrum *Palauchenia* agrees with *Auchenia*; in *Camelus* it is convex at the periphery, slightly depressed at the centre.

The hypapophysial ridge (Plate IV. fig. 5, hy, & Plate VI. fig. 1, hy) commences in *Palauchenia* more in advance than in *Auchenia* (fig. 2, hy), which otherwise it seems to resemble; but the terminal tuberosity is broken off in the fossil.

The pleurapophysis (Plate VI. fig. 1, pl) resembles in position, direction, and length

that of Auchenia; in Camelus (ib. fig. 3, pl) it is much produced, and is more inclined downward, the pair of these processes bounding a much deeper concavity at the lower half of the vertebra.

Both in Auchenia and Camelus the sharp hind border of the process (pl) is concave, and directly continued backward into the diapophysis, d. In Palauchenia the hind border appears to be less sharp, less concave; and if this be in any way due to abrasion, a more marked difference is plainly inherent; the border, passing backward, subsides on the under part of the centrum; the diapophysial ridge (Plate VI. fig. 1, d) is continued forward 7 lines above the pleurapophysial one, and subsides midway between the pleurapophysis (pl) and the base of the prozygapophysis, z. This process is less expanded at its articular part in Palauchenia (Plate VI. fig. 1, z) than in Camelus (ib. fig. 3, z), and resembles in shape and in the extent of the infero-external strengthening ridge that in Auchenia. The notch between the prozygapophyses is wider in proportion to its depth in Palauchenia and Auchenia than in Camelus; the depression above the base of the process in both existing genera is greater than in Palauchenia.

The diapophysis (d) has a long thickened outer border parallel with its base in Palau-chenia as in Auchenia; in Camelus it is more triangular in form, terminating in a thick obtuse apex. The anterior outlet of the neural canal of Palauchenia resembles that in Camelus, being less elevated than in Auchenia.

The succeeding cervical vertebræ of Palauchenia (Plate IV. fig. 6, 4, 5, 6, 7) show the same general modifications as in existing Camelidæ, due, viz. to progressive expansion and shortening of the centrum to the seventh inclusive, to progressive elongation or enlargement of the pleurapophyses to the sixth inclusive, to the development of a pair of parapophyses on this cervical, and to the suppression of par- and pleur-apophyses on the seventh, with the superadded partial articulations (ib. 7, ff) on the hind surface of the centrum for the heads of the first pair of dorsal ribs.

In the minor characteristics differentiating Auchenia from Camelus, Palauchenia agrees with the former; of the instances of which may be noted the following:—the shape and greater relative size of the diapophyses (d) of the fifth cervical, the non-confluence in the sixth cervical (Plate VII.) of the parapophyses (p) with the pleurapophyses (ib. pl), which confluence in Camelus forms a single large deflected plate coextensive with the centrum.

Of modifications peculiar to Palauchenia, the thicker, more tuberous and more anteriorly directed pleurapophyses (pl) of the fourth, fifth, and sixth cervicals (Plate IV. fig. 6) are remarkable. In the fourth is repeated the character of the distinction and wide interval between the hind terminal ridge of the pleurapophyses (Plate IV. fig. 5, pl) and the front terminal ridge of the diapophysis (ib. d): in the fifth cervical a wide and deep depression marks this interval, of which there is no trace in the corresponding part of that vertebra in Auchenia or Camelus. In the sixth cervical the bases of the pleurand par-apophyses (Plate VII. pl, p) coalesce beneath the diapophysis (ib. d) in a degree

which makes a step toward the Cameline modification. The diapophyses are imperforate in the seventh cervical of *Palauchenia*: in that vertebra of the Dromedary's skeleton in the British Museum (673 a) the vertebral artery traverses lengthwise the base of each diapophysis; but in a specimen in the College of Surgeons' Museum (No. 3455) the vertebral arteries do not perforate any part of the vertebra. In both, as in the skeletons of the Camels, Dromedaries, and Lamas at the Jardin des Plantes, where I first (in 1831) observed the fact, the vertebral arteries enter the neural canal of the sixth cervical and perforate the neurapophyses, emerging forward at the inner side of the base of each prezygapophysis. In the seventh cervical vertebra of a Lama's skeleton in the British Museum, as in the corresponding one of that in the Surgeons' Museum (Catalogue of the Osteology, 4to, 1853, p. 578, No. 3487), the right diapophysis is perforated by the vertebral artery, the left one not.

In size and general shape the cervical vertebræ of *Palauchenia* recall those of *Macrauchenia*, but detailed comparison brings out greater differences than any of those above noted in *Auchenia* and *Camelus*.

The vertebra dentata of *Palauchenia* differs from that of *Macrauchenia\** in being more slender, in having a lower neural spine, in the shorter diapophyses, and in the non-bifurcation posteriorly of the hypapophysis.

The third and fourth cervicals of *Palauchenia* differ from those of *Macrauchenia* in the longer, narrower, but thicker and more tuberous pleurapophyses, in the convexity of the anterior surface of the centrum; and this latter character distinguishes the succeeding cervicals from the corresponding vertebræ of *Macrauchenia*, in which that surface is less convex, being nearly flat at the middle part.

Thus, the general result of the comparison of characters of the vertebræ of the neck concurs with that of the dental characters in demonstrating the former existence in America of a Cameline Ruminant as large as the largest variety of living Camel or Dromedary, with closer affinities to the Lamas and Vicugnas, yet with such departures from the dental and osteological characters of *Auchenia* as seem to justify their indication by the generic or subgeneric term *Palauchenia*, here proposed for such extinct form of American Cameline quadruped.

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<sup>\*</sup> Plate 6 & 7, Fossil Mammalia of the Voyage of the 'Beagle,' 4to, 1860.

	Palauchenia.	Auchenia*.	Camelus†.	
Second Cervical Vertebra.  Length Length of centrum Vertical diameter at highest part of neural spine Transverse diameter of hind end of centrum	7  6	in. lines. 5 3 4 3 2 0 1 2	in. lines. 9 6 7 6 4 8 2 5	
Third Cervical Vertebra.  Length of centrum Breadth of hind end of centrum Breadth across diapophyses §	2  6	$egin{array}{cccc} 4 & 6 \ 1 & 3 \ 3 & 0 \end{array}$	6 9 2 7 5 3	
Fourth Cervical Vertebra.  Length Length of centrum Breadth of hind end of centrum	$egin{array}{cccc} 8 & 9 \parallel \\ 6 & 9 \\ 2 & 9 \\ \end{array}$	$egin{array}{cccc} 5 & 4\P \ 4 & 3 \ 1 & 4rac{1}{2} \end{array}$	7 9 6 7 2 9¶	
Fifth Cervical Vertebra.  Length Length of centrum Breadth of hind end of centrum Breadth across diapophyses	6 10	$\begin{bmatrix} 5 & 0 \\ 4 & 0 \\ 1 & 6 \\ 3 & 1\frac{1}{2} \end{bmatrix}$	7 10¶ 6 6 3 3 5 3	
Sixth Cervical Vertebra.  Length Length of centrum Length of hind end of centrum Breadth across diapophyses	$\begin{bmatrix} 5 & 9 \\ 3 & 4 \end{bmatrix}$	$egin{array}{cccccccccccccccccccccccccccccccccccc$	6 10¶ 5 6 3 0 5 0	
Seventh Cervical Vertebra.  Length of centrum  Breadth of hind end of centrum  Breadth across diapophyses §	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	5 0 3 9 6 3	

Professor Leidy, as was remarked in the preliminary historical sketch of the discovery of fossil Camelines in America, has recorded interesting indications of the extension of the former range of this family of Ruminants northward of Central America.

The first of these indications to which I shall refer relates to the extinct form called "Procamelus."

The species on which the genus is founded is described as follows:—

Procamelus occidentalis, Leidy.—"This genus and species are founded on several fragments of jaws, with teeth, of several individuals of an animal allied to the Camel, and about two-thirds its size. The posterior fragment of a lower jaw presents the same general form as in the corresponding part of the Camel, but is broader at the ramus in relation with its height than in the latter. The posterior coronoid process is well de-

\* Full-sized old Auchenia lama.

- † Full-grown large var. of Camelus dromedarius.
- # Including the odontoid process, which is restored according to the proportions of that in Auchenia.
- § These are the only admeasurements which the state of the fossil vertebræ enables me to take for the purpose of comparison.
  - || From the fore end of the pleurapophysis to the hind end of the postzygapophysis.
- ¶ From the end of the prozygapophysis to that of the postzygapophysis, the pleurapophyses not extending, as in *Palauchenia*, in advance of the prozygapophyses.

veloped, and the upper part of the ramus is more strongly depressed externally than in the Lama (Auchenia). The body of the lower jaw is relatively deeper than in the Camel, though not so robust; and the two sides are co-ossified by a comparatively short symphysis.

"Six molar teeth form a closed row in the lower jaw, being two additional to the number in the Camel and Lama. The true molars and the last premolar have nearly the same form as the corresponding teeth of the Camel. The second premolar is a reduced one from that behind it; and the first premolar  $[p\ 2]$  has a laterally compressed ovate crown implanted by two fangs.

"In a small fragment of a lower jaw, in the middle of the hiatus, in advance of the closed row of molars, there is the fang of a tooth which appears to have been a caniniform premolar [p1]. The mental foramen is just in advance and below the position of this tooth. A foramen likewise exists before the third premolar [p4] of the closed row of teeth, corresponding to that more posteriorly situated in the Camel and Lama.

"As in the lower jaw, six molar teeth form a closed row in the upper jaw. The true molars, though much mutilated in the specimens under examination, appear to possess the same form as those of the Camel. The last premolar  $[p\ 4]$  is also like the corresponding tooth of the latter. The second premolar  $[p\ 3]$  is like the first one of the Camel, with the exception that it has the antero-internal fold of its crown as well developed as the posterior fold, which it joins at the base. The first premolar  $[p\ 2]$  is like the first one of the series in the Lama, having a trilobate, flattened oval crown.

				in. lines.
"Length of upper molar series		•		4 8
Length of lower molar series			•	4 10
Length of upper true molar series		•		3 0
Length of lower true molar series				3 5."

(Leidy, 'Proceedings of the Academy of Natural Sciences of Philadelphia,' March 1858, p. 23.)

The Cameloid fossil from the "probably pliocene freshwater deposits of the Niobrara Valley, Nebraska," is thus shown to be not only of markedly smaller size than the Mexican Palauchenia, but to differ therefrom, as from Auchenia and Camelus, in a more important character, viz. the number of contiguous teeth forming the molar series in both upper and lower jaws. In this respect the Procamelus offers an interesting link in the transition from the cameline to the true Ruminantia, and an additional illustration of an approach to a more generalized type of dentition in a species existing at a tertiary period anterior in time to that in which the remains of Palauchenia were found. The dentition of Palauchenia, in the number of the molar series shown in the fossil from the Mexican post-tertiaries, exemplifies an intermediate step between the dentition of Procamelus, Leidy, and that of the existing Auchenia, Illig.

The second cameline subgenus indicated by the accomplished and assiduous American palæontologist is the "Camelops kansanus, Leidy" (Proc. Acad. Nat. Sc. Philadelphia,

vol. vii. p. 172); it is described as follows:—"This genus and species are established upon a fragment of the anterior extremity of an upper jaw of an animal of the Camel family, discovered by Mr. Henry Pratten, of New Harmony, Indiana, in the gravel drift of Kansas Territory.

"The specimen consists of portions of the left maxillary and intermaxillary bones, the latter of which contains the fang of a transformed incisor, or functional canine tooth as in the Lama. The intermaxillary bone is of very much more robust proportions than in the Lama or Camel. The inclination of its nasal border approaches more the horizon than in the Lama or Camel, apparently indicating the animal to have possessed a lower and perhaps a longer face than in either of the latter genera. The gingeval border is rugged as in its congeners, and it presents two irregular pits, apparently the alveoli of incisive germs. The fang of the functional canine contained in the intermaxillary bone is laterally compressed, conical, and is an inch and a half in length. From the orifice of its alveolus it is strongly curved upward and backward, nearly on a line parallel with the curved palatal margin of the bone.

"The crown of the tooth was directed downward and outward, and at the base it is ovate in section, with the narrow end posteriorly; it measures six lines and three-fourths wide, and three lines and three-fourths transversely. A small portion of remaining enamel indicates this to have been thin and smooth.

"The small remaining fragment of the maxillary bone attached in the fossil exhibits at its broken margin the portion of an alveolus, situated an inch and three-fourths behind the tooth contained in the intermaxillary bone. It has been about four lines in transverse diameter, apparently had a direction curving downward, forward, and outward from its bottom, and probably accommodated a true canine tooth, although the position is usually far back, a necessary condition, however, in the *Camelops* from the distance to which the fang of the functional canine tooth extended backward"\*.

From the foregoing account of his materials much remains to be discovered in order to yield the generic and specific characters of Camelops Kansanus, Leidy. It is obvious that the description affords no grounds for identifying them with the Mexican fossils, the subjects of the present memoir. But it is of great interest to have such indications as Professor Leidy has recorded of the geographical extension of Cameloid forms into the Nebraska and Kansas territories of the great northern division of the American Continent, and more especially after Don A. De Castillo's discovery of Cameline remains in a locality of Central America. At the present day, as is well known, this restricted family of Ungulates is represented, in the New World, exclusively by the small Lamas, Pacos, and Vicugnas, wild or domesticated, in South America.

<sup>\*</sup> Journal of the Academy of Natural Sciences of Philadelphia, 2nd Series, vol. iii. 1856, p. 166.

# DESCRIPTION OF THE PLATES.

#### PLATE IV.

- Fig. 1. Oblique view of the outer and grinding-surfaces of the molar series of teeth, *Palauchenia magna*, nat. size.
- Fig. 2. Inner view of the same teeth, nat. size.
- Fig. 3. Outer view of mandibular teeth (with mandible and incisors restored) of *Palau*chenia magna, two-fifths of nat. size.
- Fig. 4. Outer view of mandible and mandibular teeth (Auchenia vicugna), two-fifths of nat. size.
- Fig. 5. Oblique under view of the third and fourth cervical vertebræ of *Palauchenia* magna (one-eighth nat. size).
- Fig. 6. Oblique upper view of the second to the seventh cervical vertebræ of *Palauchenia magna* (one-eighth nat. size).

#### PLATE V.

- Fig. 1. Side view of vertebra dentata, Palauchenia magna.
- Fig. 2. Side view of vertebra dentata, Auchenia lama.
- Fig. 3. Side view of vertebra dentata, Camelus dromedarius.

### PLATE VI.

- Fig. 1. Side of third cervical vertebra, Palauchenia magna.
- Fig. 2. Side of third cervical vertebra, Auchenia lama.
- Fig. 3. Side of third cervical vertebra, Camelus dromedarius.

## PLATE VII.

Side view of sixth cervical vertebra, Palauchenia magna.

The figures in Plates V.-VII. are of the nat. size. The letters &c. are explained in the text.









