## EXPLANATION OF PLATES IV. \& V.

Illustrating Mr. Salter's paper on some Palæozoic Fossils from the Bolivian Andes. Plate IV.
Fig. 1. Productus semireticulatus, Martin. Isthmus of Copacabana.
2. P. Longispina, Sow. Isthmus of Copacabana.
3. Orthis Andii, $D^{\prime}$ Orb. Santa Cruz.
4. Athyris subtilita, Hall. Isthmus of Copacabana.
5. Rhynchonella, sp. Santa Cruz.
6. Bellerophon; like B. Urii, Fleming. Isthmus of Copacabana.
7. Orthis, sp. Oruro.
8. Phacops latifrons, Bronn. Oruro.
9. Ph. Pentlandii, Sulter. Aygatchi.
10. Favosites (?), sp. Oruro.
11. Tentaculites supremus, Salter.
12. T. Saienzii, Satter.

13 a. Tentaculites, sp., and Beyrichia Forbesii, Jones. Illampu. $13 b \& 13 c$. Beyrichia Forbesii, Jones.
$\left.\begin{array}{l}\text { 14. Orthis Aymara; Salter. } \\ \text { 15, 16. Orthis, sp. }\end{array}\right\}$ Valley of Millepaya.
17. Cucullella, sp. Illampu.
18. Ctenodonta (Nucula), sp. Valley of Millepaya.
19. Arca (?) Brownii, Salter. Fig. 20. Young specimen. Illampu.

Plate V.
Fig. 1 \& 2. Homalonotus Linares, Salter. 3. Homalonotus, sp.

4, 5, \& (6. Cruziana Cucurbita, Salter.
7 \& 8. C. Unduavi, Sulter.
9. Boliviana Melocactus, Salter.
10. B. proboscidea, Salter.
11. B. bipennis, Satter.
3. On a New Species of Macrauchema (M. Boliviensis). By Thomas H. Huxley, F.R.S., Sce. G.S., Professor of Natural History, Government School of Mines.

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The vertebrate remains obtained by David Forbes, Esq., F.R.S., F.G.S., from the mines at Corocoro, under the circumstances detailed in his paper " On the Geology of Bolivia and Southern Peru," consist of the following parts of the skeleton of apparently one and the same Mammal:-1. A portion of the right maxilla and palate, with fragments of grinding teeth. 2. Rather more than the right half of the occipital portion of the skull. 3. A middle cervical vertebra, nearly entirc. 4. A fragment of a posterior lumbar vertebra. 5. A small portion of a right scapula. 6. A crushed fragment of the proximal end of an ulna. 7. Part of the proximal end of the left tibia. 8. The entire left astragalus, and part of the right astragalus.

## $\mathbb{C A} \mathbb{R} \mathbb{B} \mathbb{O} \mathbb{N} \mathbb{F} E \mathbb{R} \mathbb{D} \mathbb{U} S$



FOSSIIS from the ANDES.



The bones are all in the same, and that a very peculiar, mineral condition-the Haversian canals being for the most part filled up with threads of native copper; so that the fossils are not only exceedingly dense, but, in consequence of their internal flexible metallic support, their thinner and more delicate parts bend, rather than break, when force is applied to them.

The characters of the cervical vertebra and of the astragalus, which are fortunately the best-preserved of all the fossils, at once demonstrated the remains to belong to the genus Macrauchenia (Owen), while the entire absence of epiphysial sutures in the vertebre and the long bones, and of similar indications of immaturity in the fragment of the skull, proved the animal to have attained its adult condition. The vertebra and the astragalus, however, have not more than half the size of the corresponding bones of the species, M. Patachonica, discovered by Mr. Darwin, and deseribed by Professor Owen in the 'Appendix to the Voyage of the Beagle'; and as, in addition, these and the other bones present different proportions from those of the Patagonian species, I have no hesitation in regarding the fossils collected by Mr. Forbes as the remains of a distinct species, for which I propose the name of Macraucheria Boliviensis. It will be convenient to commence the description of these fossils with those parts upon which the diagnosis of the species may be most safely rested, viz. the cervical vertebra and the astragalus.

The cervical vertebra (Plate VI. fig. 1). -The grat length of the centrum of this vertebra, the peculiar form of its transverse processes, and the absence of perforations for the vertebral arteries in them are characters which, in the present state of knowledge, oblige the anatomist at once to refer it either to one of the existing Camelider or to the genus Macrauchenia; while the two strong, converging ridges which mark the posterior half of the under surface of the vertebra, and meet to form a single ridge, which dies away anteriorly in the middle of that surface, togetherwith the slight concavity of both the posterior and the anterior articular faces of the centrum, are decisive in favour of the latter alternative. In fact, the excellent description of the cervical vertebre of Macrauchenia Patachonica which has been given by Professor 0 wen applies so well to that of M. Boliviensis, that, referring to the paper in the 'Appendix to the Voyage of the Beagle,' already cited, for a gencral account of the characters of Macrauchenian vertebre, I shall contont myself with pointing out the resemblances and differences of the Bolivian from the Patagonian Macrauchenia, and from the existing Auchenice. The dimensions of the centrum of the cervical vertebre of the two Macrauchenice, and of the fourth cervical of a Guanaco and of a Vicugna in the College of Surgeons' Museum are as follows:-

|  | M. Boliviensis. | M. Patachonica. | Guanaco. |
| :--- | :---: | :---: | :---: |
| in. | Vicugna. |  |  |
| in. | in. | in. | in. |
| Length. .......... $3 \cdot 8$ | $6 \cdot 6$ | $4 \cdot 6$ | $4 \cdot 0$ |
| Width of anterior face | $1 \cdot 1$ | $3 \cdot 2$ | $1 \cdot 1$ |
| Width of posterior face | $1 \cdot 25$ | $3 \cdot 4$ | $1 \cdot 3$ |

Thus it appears that the centrum of the cervical vertebra of Macrauchenia Boliviensis is far more slender than that of M. Patachonica; for, while the length of the former is to that of the latter as 1:17, the transverse diameters of the anterior faces of the centra of the two species are, noarly, as $1: 3$. The cervical vertebra of the new species is, absolutely, rather shorter than the fourth cervical of the Vicugna; but, relatively to its width, it is much shorter and stouter than this bone in either the Guanaco or the Vicugna. There are no longitudinal ridges on the surface of the vertebra below the prezygapophyses, in which respect M. Boliviensis differs from M. Patachonica, and approaches the Auchenio. The anterior articular facet of the centrum is concave from above downwards, in consequence of the projection of the thickened and convex lower third of that face; the posterior facet is not only concave from above downwards from a similar cause, but is also coneave from side to side. The concavity of both articular facets is greater than in M. Patachonica, and the present species departs, in these respects, more widely than the latter does from the Auchenice.

The astragalus (Plate VI. fig. 2).-This bone is, again, quite that of the Patagonian species in miniature, differing chiefly in the proportions of its dimensions, as shown by the subjoined table:-

|  | Macrauchenia Bolivionsis. in | M. Patachonica. in. | Guanaco. in. | Vicugna. in. |
| :---: | :---: | :---: | :---: | :---: |
| Length | $1 \cdot 45$ | $3 \cdot 3$ | $1 \cdot 6$ | $1 \cdot 3$ |
| Greatost | dth .. 1•2 | $2 \cdot 7$ | $1 \cdot 2$ | $\cdot 85$ |
| Greatest | pth .. 85 | $2 \cdot 15$ | -95 | -8 |

If we take the lengths of tho astragali, it will be observed that their proportions in the Bolivian and Patagonian Macrauchenice are not the same as those of the cervical vertebre. The astragali bear the ratio of $1: 2 \frac{1}{3}$, while the cervical vertebre gave $1: 1 \frac{7}{9}$. Furthermore, the proportions of length, width, and depth in the two astragali are different. Like the cervical vertebra, the astragalus of $M$. Boliviensis is a, relatively, stouter bone than that of the Vicugna; though instead of being shorter it is a little longer, occupying a position, in point of absolute length, between the astragalus of the Vicugna and that of the Guanaco. As the astragalus thus yields results agreeing very woll with those giren by the cervical vertebra, we may safely assume that not only the absolute size, but the proportions of the body of Macrauchenia Boliviensis were nearly those of the existing Llamas, and differed widely from those of the heavy and huge Macrauchenia Patachonica.

The tibia.-What remains of the bones of the hind leg confirms this riew of the proportions of Macrauchenia Boliviensis. I have the proximal end of the left tibia, minus the fibula, and with the outer articular condyle broken away. Below this point, the outer edge and surface of the fragment are uninjured, and the posterior face is in good preservation, but the internal face is somewhat crushed. The muscular ridges on the posterior face are as well marked as in the skeleton of the Guanaco, and far more distinct than in that of
the Vicugna, yielding additional evidence of the adult condition of the animal, to that afforded by the absence of epiphyses.

The antero-posterior diameter of the tibia, measured from the posterior edge of the intermal articular facet to the anterior edge of the crest of the tibia, is, in-

| M. Boliviensis. | M. Patachonica. | Guanaco. | Vicugna. |
| :---: | :---: | :---: | :---: |
| in. | in. | in. | in. |
| $2 \cdot 4$ | $5 \cdot 4$ | $2 \cdot 3$ | $2 \cdot 1$, |

so that the depths of the proximal ends of the tibir of the two Macrauchenice have the ratio of $1: 2 \frac{1}{4}$, which corresponds very well with the proportions of the astragali, and confirms the conclusions already arrived at, as to the relative lightness of the limbs of this species in comparison with those of M. Patachonica, and as to the similarity of the proportions of the Bolivian species to those of the Llamas.

What remains of the outer edge of the tibia is sufficient to prove that the fibula must have remained unanchylosed to the tibia for a much greater distance than in the Patagonian species. From the manner in which the outer tuberosity of the proximal end of tho tibia is broken off, I am inclined to suspect that the fibula was anchylosed to it at this point; and perhaps, as in the Auchenice, its proximal end was represented only by a bony style.

The scapula is represented merely by a mutilated fragment, comprising the glenoid cavity and the adjacent parts. The spine of the scapula is broken off, and the glenoid cavity is somewhat distorted by the bending of one of its edges; but enough remains to show that the bone must have agreed with the scapula of Macrauchenia Patachonica in all essential respects, and that it therefore differed very widely from that of the Auchenice. In size, however, it nearly corresponded with the corresponding bone in the latter animal; for the greatest diameter of the glenoid cavity is 1.2 in ., the same measurement in the Vicugna being $1 \cdot 0$, and in the Guanaco $1 \cdot 6$.

The ulna.-The fragment of the ulna, consisting of part of the olecranon process and of the sigmoid cavity, is so crushed, that I can only affirm its general agreement in form with that of Macrauchenia Patachonica, and in size with the same bone in the Llamas.

The lumbar vertebra.-Of bones referable to this region of the body, again, there is but a single fragment, of value only so far as it confirms the conclusions arrived at by the examination of the more perfect fossils. It corresponds very well with the posterior half of the centrum of the penultimate lumbar vertebra of M. Patachonica in form, and with the corresponding vertebra of Auchenia in size; but the crest into which the middle of its under surface is raised, and which is still sharper than that in the Patagonian species, diagnosticates it at once from any of the lumbar vertebre of the Llamas.
The transverse diameter of the articular face is $1 \cdot 1$ in., its vertical diameter $0 \cdot 9$. The corresponding measurements of the antepenultimate lumbar vertebra of $M$. Patachonica are $3 \cdot 0 \mathrm{in}$, and $2 \cdot 1$; so
that, as in other bones, the proportions of diverse diameters of the same bone are not the same in the two species. But as the transverse diameters of the corvical vertebre of the two species are nearly as $1: 3$, and the transverse diameters of the lumbar vertebre are, also, nearly in the ratio of $1: 3$, it would soem as if the different regions of the vertebral column of the two species exhibited the same proportional correspondence to one another.

The slcull.-As no part of the skull of Macrauchenia Patachonica has yet been discovered (with perhaps the exception of part of the lower jaw), a great interest attaches to every fragment which promises to throw light upon this part of its organization; and I therefore make no apology for dwelling at some length upon the characters of the two very imperfect and mutilated portions of the cranium which turned up among the specimens submitted to me by Mr. Forbes.

The one of these (Plate VI. fig. 3) consists of rather more than half of the occipital segment of the skull, and exhibits the whole of the supra-occipital bone, with its strong occipital crest, a part of the parietal with the sagittal crest, the greater part of the right paramastoid process, and the entire right occipital condyle.

As I have already remarked, the sutures are obliterated: and this is true, not only of those which ordinarily exist between the elements of the occipital bone in young mammals, but of the lambdoidal suture, which usually persists for a longer period. The occipital foramen must, when entire, have had a depressed-oral form, the short, vertical axis of the oval being about $0 \cdot 6$ of an inch long. The face of the bone above it inclines upwards and forwards, at an angle of about $50^{\circ}$ with the base of the skull, and presents a sharp ridge in the middle line, on either side of which the surface of the supra-occipital element slopes with a slight convexity outwards and forwards, at the sides and below; while, above, it becomes concave by passing almost vertically upwards in the middie line, and laterally, bending upwards and backwards at a right angle with its previous inclination into the occipital crest.

This crest is nearly 0.2 inch thick at the sides, and becomes still thicker in the middle line, where it joins the sagittal crest. It is $1 \cdot 1$ inch in diameter at its widest part, and about half an inch high. Its contour is that of a parallologram, with its angles rounded off, and the middle of its upper side rather truncated. The lateral portions project backwards rather more than its centre; so that, while, supposing the basi-occipital to be horizontal, a vertical line drawn through the posterior edge of that bone would nearly coincide with the contour of its central part, it would pass a little anterior to the plane of the lateral extremities of the crest. Inferiorly, the thick lateral portions of the crest divide into two vidges; the posterior of which turns slightly inwards and comes to an enil, while the anterior, much sharper at its edge, passes forwards and outwards, and becomes continuous with the sharp ridge in which the paramastoid process terminates externaily.

Behind this ridge, between the paramastoid process, the occipital condyle, and the lateral convexity of that part of the occipital bone which lies above the foramen magnum, there is a deep fossa, which is
divided into two portions by a transverse ridge, extending from the outer and upper part of the condyle to the posterior and inner face of the paramastoid process. The large precondyloid foramen (probably somewhat enlarged accidentally) opens into the lower and anterior division of the fossa, beside the condyle, and about $\frac{1}{6}$ th of an inch behind its anterior inferior boundary. The upper boundary of the foramen magnum is almost straight, and its summit is below the level of the superior edge of the condyle (when the base of the skull is horizontal). The condyle is divisible into an upper, smaller, obliquely ascending, and a lower, more nearly horizontal facet. The line of junction between the two, forming the posterior limit of the condyle, is rounded off and is directed obliquely outwards and upwards. The moderately convex upper facet looks upwards, backwards, and but very slightly outwards. It is broad above, where its transverse diameter amounts to nearly half an inch, and tapers off gradually to a point below and internally.

The inferior facet, less curved than the other, is 0.6 of an inch wide behind, hardly more than half that in front, and fully 0.8 of an inch long. It is slightly convex from side to side, and from behind forwards, posteriorly, where it looks downwards and outwards; convex from side to side, and slightly concave from behind forwards, in front, where it is directed more horizontally downwards. Its anterior narrow end has a sharply defined rounded margin, which can be traced to the anterior boundary of the occipital foramen; so that the occipital condyles certainly did not coalesce in the middle line.

The paramastoid process is broken off rather above the level of the lower boundary of the occipital condyle; but, from the thinness of the fractured edge, I imagine it did not extend much further. It is broad and flattened, the direction of its greatest diameter being from behind and without, inwards and forwards. Its posterior face is directed as much inwards as backwards, and its outer margin is sharp, except towards the lower end, where it becomes rounded. Internally, it thickens before rejoining the exoccipital, in front of, and external to, the precondyloid foramen. The upper part of its anterior and external face is evidently rough and has united with the mastoid, now completely broken away; but it is difficult to say how far downwards the sutural face extended. The posterior boundary of the jugular foramen is preserved on the inner side, and in front of, the thick inner edge of the paramastoid.

The sagittal crest is continued forwards from the triangular prominence common to it and the occipital crest, and at once becomes very thin and sharp. It is broken off at a very short distance from its commencement, and at this point it is a quarter of an inch high. Its superior margin is not parallel with the contour of the middle line of the parietal region, but has a more marked upward inclination, so as to lead one to suppose that the crest rose to a considerable height in the middle of the synciput,-a conclusion which is strengthened by the great thickness of the parietals (of whose median suture no trace is visible) in the middle line. The transverse section presented by the anterior broken edges of these bones is, in fact, triangular,
and the height of the triangle from its apex, which corresponds with the base of the crest, to its base (the concave inner wall of the cranium) is nearly $0 \cdot 4$ of an inch.

In viewing the fragment of the occiput from within, one is surprised by the great thickness of the supra-occipital region, the bone immediately above the middle of the occipital foramen being half an inch thick. A well-marked ridge, defining the interior boundary of the cerebellar fossa, is continued downwards, forwards, and outwards, from the anterior boundary of the thick roof of the occipital foramen. There is no venous canal traceable above the inner aperture of the precondyloid foramen.

If the occiput of Macrauchenia Boliviensis be restored by reversing the outlines of the right half (as in Pl. VI. fig. 3), thus supplying the wanting left moiety, the following measurements may be obtained. Side by side with them I give the corresponding measurements of the skull of the Vicugna:-

Transverse diameter of the occiput
from the outer edge of one paramastoid to that of the other .... Ditto from the outer edge of one occipital condyle to that of the other. The transverse diameter of the occi-
pital foramen.
M. Boliviensis.
in.
in.
1.9
1.5
$.7 \quad .7$

It will be observed that the two series of dimensions correspond very closely, the two latter being identical, while the Macrauchenia appears to have had even a narrower skull than the Vicugna. In form, the occiput of Macrauchenia agrees better with that of the Llamas than with that of any other ungulate animal with which I have compared it.

Thus, in an old Guanaco I find an equally well-marked ridge in the middle line of the supra-occipital element; the occipital crest is equally prominent, though not so stout; the sagittal crest is as well marked, thin and sharp, and, as in Macrauchenia, its superior edge ascends. There is a fossa between the occipital condyle and the paramastoid, similar in form to that in Macrauchenia, though much shallower. The occipital condyles are very much alike; and their relation to the precondyloid foramina is the same in both cases. The paramastoid has the same proportional breadth; and its greatest diameter is, in both cases, directed from without and behind, inwards and forwards: in both cases its inner edge is peculiarly thickened. Again, the paramastoid of the Auchenia, like that of the fossil, is very short, its apex hardly extending below the level of the occipital condyle.

The occiput of Macrauchenia, on the other hand, differs from that of Auchenia in the much greater thickness of the supra-occipital, which in the Macrauchenia has fully double the thickness of the same region in an old Guanaco, whose skull is much larger-in this respect approaching the Sheep and some other Ruminants, which have this bone very thick. The supra-occipital, also, is much higher, in proportion to its width, in Macrauchenia than in Auchenia; its lateral'
contours are parallel, and not divergent outwards and upwards, There is nothing in the Macrauchenia resembling the deep notch between the supra-occipital and the base of the paramastoid, into which a part of the mastoid fits in Auchenia. In contour, in fact, the occiput of the Macrauchenia resembles that of the Palreotherium more nearly than that of any other Mammal. But, on the whole, I think it must be admitted that the resemblance of the back of the skull of the Macrauchenia to that of Auchenia is sufficiently close to justify the conclusion, that the predominance of the Cameline type, so marked in the neck, was maintained in the head of the extinct Mammifer.

The fossil which remains for description (Plate VI. fig. 4) consists of two fragments of the matrix ( $a$ and $b$ ), which fit together, and to which adhere certain portions of the upper jaw and palate, together with the fractured remains of three grinding-teeth and part of the alveolus of a fourth, all of the right side, and in a continuous series. The alveoli and part of the crowns of these teeth are contained in the larger fragment of matrix,--the smaller fragment fitting against the larger and the tecth which it contains, and exhibiting the impressions of the grinding surfaces of three teeth and of their inner faces, a portion of dental substance adhering to the latter, in the case of the two anterior teeth. Of the hindermost tooth nothing is left but the impression of one fang.

The impression of the grinding surface of the first tooth is nearly four-tenths of an inch long, convex from before backwards, concave internally: the outer boundary of the impression is broken away, a fragment of dental substance adhering to the posterior part of its inner face. The part of the larger portion of the matrix (a) which should contain the alveolus of this tooth is absent. The anteroposterior extent of the coronal impression of the second tooth is a little more than 0.4 of an inch; it is concave from before backwards externally, nearly flat internally, and shelves with a slight convexity upwards and inwards. The inner boundary of the impression is, as in the preceding case, markedly concave; and a much larger fragment of tooth-substance adheres to it. The outer boundary of the impression is broken away, but much more in front than behind, where its width is fully 0.4 of an inch. The impressed line which separates this impression from the next is convex forwards. Corresponding with this impression there are, in the larger fragment of matrix, an almost entire conical posterior fang, about 0.4 of an inch long, lodged in a complete bony alveolus, whose outer wall is broken away, and the posterior half of a similar alveolus for an anterior fang: there is no trace of a third alveolus or fang; and, indeed, there seems to be no room for one. The fang which exists is connected below with a portion of the crown; but this is so broken, that all that can be remarked of it is its marked internal convexity.

The coronal impression of the third tooth is half an inch long; like the preceding, its face shelves upwards and inwards. The posterior part of its outer margin is broken away; butit is clear that this crown was quite as wide as that which preceded it, if not wider;
the surface appears, however, to have been more evenly flat. The inner perpendicular face of the impression presents two concavities, separated by a slight ridge.

More of this tooth is preserved than of any other ; the outer wall of the maxilla is, for the most part, preserved over it, and encloses the alveoli of two external fangs. There is evidently at least one, and perhaps two, internal fangs. The whole thickness of the inner and posterior part of the crown is preserved, and the posterior and inner half of its worn face; the rest of the tooth is broken away. The posterior and outer fang, partially exposed, is 0.3 of an inch long, conical, and slightly inclined backwards, as well as upwards and inwards. The crown, where it joins the fang, is 0.4 of an inch long; so that it must have widened a little below. The vertical height of the crown of the tooth posteriorly and internally is hardly more than $0 \cdot 15$; anteriorly and internally it is broken ; but, when entire, it had a height of at least $0 \cdot 2$. The inner surface of the tooth is divided into two tolerably well-marked subcylindrical faces, which correspond with the impressions on the inner wall of the coronal impressions.

The outer moiety of the crown is altogether broken away ; the inner moiety, broken anteriorly, exhibits in its posterior half a smoothly worn facet, concave from before backwards, and inclined not only downwards but slightly backwards. A narrow fringe of enamel appears to surround the worn dentine of this face, which is wider in the middle than at the two ends. The true outer face of the enamel can be traced from the inner face of the tooth, continuously, round the posterior boundary of this worn facet, and as far as its most dilated portion on the inner side. It is concave outwards, and presents a slight inflexion midway between the posterior end of the facet and its middle dilatation. Beyond the dilated middle of the facet, its enamel-wall seems to have been united with that of the opposite half of the tooth; but it is traceable forwards, becoming concave externally, past the anterior end of the worn facet, to the anterior margin of the tooth, where it bends round and again becomes continuous with the enamel of the inner face.

This tooth, therefore, appears to have possessed an internal division, elongated from before backwards, surrounded by a narrow band of enamel,--having its inner contour produced into two convexities, separated by a slight vertical depression, while its outer wall presents two concavities, separated by a slight ridge which lies rather behind the level of the depression on the inner face. By use, the posterior part of this division wore down into a facet, concave from before backwards, and separated, by a transverse ridge, from the facet in front of it. A longitudinal fossa separated the posterior moiety, at least, of this division of the tooth from the outer division.

Imperfect as is this fragmentary grinder, certain important conclusions may, I conceive, be very safely drawn from its structure. The predominance of the longitudinal, to the exclusion of transverse valleys and ridges in the crown of the tooth, the distinct, though not strongly marked, crescentic form of the internal division of the tooth, and its short crown, remove it from the teeth of any known

Perissodactyle Mammal, and lead one, at once, to seek its analogue among the Artiodactyla; and of these the Ruminants alone, so far as I know, offer anything like it. The inner grinding-surface of any true molar of a Ruminant, however, exhibits two ridges and three depressions; while that of the Macrauchenia has only one ridge, with a concave shelving depression behind, and doubtless, in the perfect condition, another in front; in other words, it has the contour exhibited by one of the hinder premolars of a Ruminant. The inner division of a posterior premolar of Auchenia has its convex inner surface undivided by any vertical depression; and its outer, posterior margin exhibits no marked inflexion: but such an inflexion exists in the corresponding teeth of the Giraffe and of many Deer, in some of which latter a vertical groove, dividing the inner face into two convexities, may also be noted.

I am of opinion, therefore, that the tooth in question is a posterior premolar, and that it was constructed upon the Ruminant type. In this case, however, the dentition of Macrauchenia must have departed widely from that of the Camelider ; for there were certainly two teeth with flat grinding crowns in front of that just described, which would give, at least, three premolars in all, or as many as are found in ordinary Ruminants.

I am strengthened in the conviction that there were as many as three premolars, by the rest of the structure of this interesting fragment. Within the series of teeth just described, in fact, it presents a considerable portion of the roof of the palate, some of whose bony matter remains. At a distance of half an inch from the inner wall of the posterior premolar, a longitudinal sutural line traverses the whole length of the palatine surface, and ends abruptly (in consequence of the fracture of the matrix) as well behind as in front. Its posterior end is 1.2 of an inch behind a transverse line drawn at the level of the posterior margin of the last premolar. Opposite and behind this tooth, the right half of the palate is marked by what might hastily be taken for a suture, but which is nothing but a fracture. Behind it, and 0.9 of an inch in front of the posterior end of the longitudinal suture, two curved transverse lines, convex forwards, which I believe to be the maxillo-palatine sutures, pass into the longitudinal suture.

Thus, it is clear that the palate must have extended back for 1.2 of an inch behind the third grinding-tooth.

Supposing this tooth to have been succeeded by three others whose length, if they were molars, would be probably between 0.6 and 0.7 of an inch, it follows that the posterior margin of the palate must have extended, at least, as far back as the posterior margin of the second molar. This is further than it extends in the Auchenice (the very forward extension of whose palatine aperture is exceptional among the Artiodactyla), but it is not so far as in the Camel, where the posterior boundary of the palate is opposite the middle of the last molar*.

* The attempt to differentiate the Artiodactyla and Perissodactyla absolutely by the position of the posterior margin of the bony palate is fallacious. On an

This backward extension of the palate is, so far as it goes, in favour of the view to which the consideration of the dentition and the structure of the occiput leads, viz. that the cranium of the Macrauchenia was constructed upon an essentially Artiodactyle type.

The following are the dimensions of the palate and teeth of $\mathrm{Ma}-$ crauchenia Boliviensis, and those of the corresponding parts in the Vicugna:-

## Macrauchenia. Vicugna.

Width of palate inside the grinding teeth*
Antero-posterior length $\{$ more than $2 \cdot 0$ \}
of four grinders.... $\{$ less than 2.5$\}$
$1 \cdot 25$ (at widest).

The narrower palate of the Macrauchenia agrees with its narrower occiput, while it exhibits the same general correspondence with the Vicugna as has been met with in the limbs and vertebre.

Thus I conceive that an attentive examination of these scanty remains is sufficient to prove that, when they were imbedded, there lived in the highlands of Bolivia a species of Macrauchenia not half as large as the Patagonian form, and having proportions nearly as slender as those of the Vicugna, with even a lighter head; and it is very interesting to observe that, during that probably post-pleistocene epoch, a small and a large species of more or less Auchenoid Mammal ranged the mountains and the plains of South America respectively, just as at present the small Vicugna is found in the highlands, and the large Guanaco in the plains of the same continent $\uparrow$.

The structure and geological date of the genus Macrauchenia may serve, if taken together, to point an important palæontological moral. Professor Owen, in the able memoir cited above, has clearly pointed out the remarkable combination of Artiodactyle and Perissodactyle characters exhibited by Macrauchenia, which unites the eminently characteristic cervical vertebræ of the Artiodactyle Camelidee with the three-toed fore foot and the triply trochantered femur of the
average it is doubtless true that the bony palate extends further back in the former than in the latter; but the bony palate extends to a line joining the anterior edges of the last molars in Hyrax; while in the full-grown Guanaco, a similar line is 0.4 of an inch behind the posterior boundary of the palate.

* The six grinding-teeth of the lower jaw, which Professor Owen has provisionally referred to Macrauchenia (British Association Reports, 1846), are said to form a series 9 inches long. A series of six such teeth of the lower jaw of Macrauchenic Boliviensis could not have exceeded 4 inches in length, and was probably shorter. Under these circumstances, the heads (as measured by. the teeth) of the two species would be in nearly the same proportion as their astragali, and in very different proportions from their cervical vertebræ. This is not improbable; for the Vicugna has a much lighter head than the Guanaco, if the cervical vertebre be taken as the standard. The length of the fourth cervical of the Vicugna is to that of the same bone in the Guanaco as $1: 1_{7}$, while the length of the head in the two is as $1: 1 \frac{1}{2}$.
$\dagger$ As the Guanaco ranges into the highlands, it may not be a too sanguine expectation to hope for the future discovery of remains of the great Macrauchenia, also, in Bolivia.

Perissodactyla ; and with an astragalus which, in the apparent entire absence of any facet for the cuboid, is, I may affirm, more Perissodactyle than that of any member of the order, except Hyrax.

None of the older Tertiary mammalia can produce such strong claims to be considered an example of what has been termed "a generalized type" as Macrauchenia; and yet there seems little doubt that the latter is the South American equivalent, in point of age, of our Irish Elk!

Again, Macrauchenia, alone, affords a sufficient refutation of the doctrine, that an extinct animal can be safely and certainly restored if we know a single important bone or tooth. If, up to this time, the cervical vertebræ of Macrauchenia only had been known, palæontologists would have been justified by all the canons of comparative anatomy in concluding that the rest of its organization was Camelidan. With our present knowledge (leaving Macrauchenia aside), a cervical vertebra with elongated centrum, flattened articular ends, an internal vertebral canal, and imperforate transverse processes, as definitely characterizes one of the Camel tribe as the marsupial bones do a Marsupial,-and, indeed, better; for we know of recent non-marsupial animals with marsupial bones. Had, therefore, a block containing an entire skeleton of Macrauchenia, but showing only these portions of one of the cervical vertebræ, been placed before an anatomist, he would have been as fully justified in predicting cannon-bones, bi-trochanterian femora, and astragali with two, subequal, scaphocuboidal facets, as Cuvier was in reasoning from the inflected angle of the jaw to the marsupial bones of his famous Opossum. But, for all that, our hypothetical anatomist would have been wrong; and, instead of finding what he sought, he would have learned a lesson of caution, of great service to his future progress.

## EXPLANATION OF PLATE VI.

Fig. 1. Cervical vertebra of Macrauchenia Boliviensis, Huxley; restored from the opposite side, posteriorly.
$1 a$. The same vertebra, viewed from in front.
1 b. The same vertebra, viewed from behind.
2. Astragalus (left), from above.

2 a. " " from below.
$2 b$. "" from the outer side.
3. Fragment of the occipital portion of the cranium, restored in outline.
$3 a$. The same fragment, viewed from without and laterally.
4. Part of the upper jaw and palate, and lateral view ( $a$ ) of the crown of the most perfect tooth.
$4 a$. Side-view of the large fragment of the matrix containing the teeth, with the smaller fragment, exhibiting the coronal impressions, adapted to it.


