STUDIES IN TASMANIAN MAMMALS, LIVING AND EXTINCT.

Number IV.

Nototherium mitchelli.

Appendicular Skeleton, including the manus and pes (hitherto unknown).

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Plates XXII.-XXIII.

(Read 13th September, 1920.)

INTRODUCTORY NOTE.

The feet of the *Nototheria* have hitherto remained undescribed from associated specimens, although many bones in museum collections have been relegated to the genus. The calcaneum, and astragalus, of *Nototherium tasmanicum* were recovered with the rest of the skeleton in 1910, and the astragalus of *Nototherium victoriæ*, came to light with other associated remains from King Island in 1912. Of the foot of *Nototherium mitchelli*, we have now to record the following bones, all parts of a single pes, and the associates of the skeleton unearthed at Smithton, in 1920, namely:—

(1) Astragalus.
(2) Calcaneum.
(3) Navicular.
(4) Cuboid.
(5) Ento-cuneiform.
(6) Ecto-cuneiform.
(7) Two metatarsals.
(8) One ungual phalanx.

For all practical purposes this outlines the foot, and as the bones, in a general way, conform to the *Diprotodon* type, it will be easy to restore the missing parts, the more so as the hand is complete in phalangeals, and claw bones, and therefore available for comparison. A glance at the outlines of the hand and foot quickly reveal the disproportion exhibited by the pes, in point of size. This, however, is compensated for in the wide expanse of the sacral regions of the skeleton, sheer weight and pelvic width making up for other reductions.

In the hands, one cannot but be struck by the great palmar expanse, as also the power of the claws. When fully spread such hands would have firmly gripped the soil, and thus presented a most solid and unyielding front to a charging foe. Such manal power must have been a useful factor also during the cranial twist incidental to the horning and tossing of a foe. In this connection it is manifestly obvious that the whole build of the scapular arch is in view of power, and the scapulæ, clavicles, and arm bones, are all called upon to contribute their quota to the total result.

OSTEOLOGY OF THE FOOT.

Plate XXII.

As the astragalus and calcaneum from the left pes of both *Nototherium mitchelli* and *N. tasmanicum* are present, a direct comparison can be instituted, and, with the astragali super-imposed upon their respective calcanei, the following notes were obtained. In spite of the fact that the femur of *N. mitchelli* exceeds that of *N. tasmanicum* in total length by 65 mm., and in width by 47 mm., the bones of the feet present hardly any differences in point of total size, although morphologically they manifest such well-marked differences as one would look for upon their taxonomic segregations. Unfortunately, the post-articular regions of both calcanei are mutilated, and accordingly no measurement of total length can be supplied, that of *N. tasmanicum* is the longer, being 152 mm., while that from the other species is only 127 mm. long. In the former, the whole post-articular muscular attachment area is present, and extends backwards for 50 mm., while in the latter only 25 mm. of this region is present.

The lateral tibial articular tract in *N. mitchelli* is horizontal, but in the other species it slopes forward and downward, is gently concave in the former, and convex in the latter, thus giving a more vertical tibial articulation to *N. mitchelli*, and markedly more angular one to *N. tasmanicum*. In *N. mitchelli*, the calcaneum presents a fibular articular facet 20 mm. long, and 8 mm. deep, the calcaneum projecting some 8 mm. beyond the astragalar

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facet. In *N. tasmanicum*, the astragalus overhangs the calcaneum, owing to the greater slope (noted *supra*), thus masking completely the primitive character of a fibular calcaneal articulation, strongly manifested by *N. mitchelli*. To followers of the evolutionary trend, this character will serve to recall the fact that the most primitive member of the sub-order *Perissodactyla*, namely, *Macrauchenia*, exhibited this character, as also did the several members of the sub-order *Taxodontia*. The suppression of such an osteological item should be of taxonomic importance. (1) In conformation with the abovenamed differences between the two astragali under consideration, every other articular surface, and facette, shows similar variations, the details of which it is unnecessary to give, since the articulation of the fibula with the calcaneum, by a well-marked surface, will serve to classify the moiety with the *Megacerathine Nototheria*, and the absence of such will relegate it to the *Leptocerathine* group.

The total height of the superimposed bones in *N. tasmanicum* is 120 mm., and that of *N. mitchelli* 122 mm., their astragalar widths (in articular position) being 82 mm. and 74 mm. respectively. For the classification of fragments of calcanei the best guide in the absence of the evidence yielded by the fibular facet, is that of the whole articular surface. In *N. mitchelli*, the sizes are 80 mm. in antero-posterior length, with a width of 70 mm., while in *N. tasmanicum*, the surface is 60 mm. x 60 mm. The antero-posterior slope in *N. mitchelli* is only 30 degrees, while in *N. tasmanicum* it is 50 degrees. When perfect, the two sets of bones must have been fairly similar in point of size and robustness. It is most unfortunate that the bones of the tarsus and toes are unknown in *N. tasmanicum*, as the digital reduction may have—indeed, we feel convinced must have—shown interesting grades when compared with those of *N. mitchelli*.

As far as we can judge (working only from photographs of the foot of *Diprotodon*), the articular cup for the astragalus is formed in the *Nototherium*, in about the same proportions as that which obtains in *Diprotodon*, namely—

(1) The largest share by the navicular.

(2) The next in importance being that contributed by the calcaneum.

(3) The minimum share being supplied by the cuboid.

(1.) In the kangaroo, the primitive character is retained, *in toto*, the fibula being elongated to reach the articular facet of the calcaneum—to the amount that the astragalus rises above that bone, in this region It's almost suppression in *N. mitchelli*, and its total suppression in *N. tasmanicum*, are the facts to be kept in sight.

With Dr. Stirling's photo of the *Diprotodon's* pes (2) placed side by side with the foot of *N. mitchelli*, we note that in the latter—

1. The external horn of the navicular is much more expanded at the base.
2. The ecto-cuneiform is more elongated.
3. The ento-cuneiform is relatively more robust.

As far as it is fair to express an opinion, we would state that our material suggests less reduction of the toes than obtains in the *Diprotodon*. Allowing for missing bones, and, therefore, in part open to future emendation, the following set of measurements are submitted:—

Total length of foot = 355 mm.
Greatest width = 171 mm.
Width of toes = 105 mm.

The *Nototherian* astragalus does not closely simulate that of the Wombat, but, if that bone from the foot of the Tasmanian Wombat is compared with the two astragali of the *Nototheria* just passed in review, it will be found to agree better with that of *N. tasmanicum* than the corresponding moiety from the pes of *N. mitchelli*. We have no bone to contrast, and compare with, from the platyrhine wombat, but we strongly suspect the astragalus from that animal would agree best with *N. mitchelli*, and so follow out the sequence so frequently noted during our studies.

THE MANUS.

Plate XXIII.

As with the pes, so with the manus, the parts present belong to the left side, and are not quite intact as to several moieties. We hold the following, however:—

(1) Pisiform.
(2) Cuneiform.
(3) Unciform.
(4) Scaphoid.
(5) Magnum.
(6) All five metacarpals.
(7) Four phalanges of the proximal series.
(8) All five ungual phalanges.

From the carpus there are missing the following bones, namely:—

(1) Trapezoid.
(2) Trapezium.
(3) Scaphoidal sessamoid.

Also six phalanges.

(2.) Foss. Lake Callabonna, vol. I., part 1, plate 10.

NOTOTHERIUM MITCHELLI —MANUS.

As the pisiform, and cuneiform, outline the ulnar cup, and the scaphoid can be articulated to the end of the radius, the loss of the items named will not seriously affect the articulation of the hand, the presence of the complete set of metacarpals is most fortunate, as is also the set of ungual phalangeals. Finger five is intact, and so a measurement taken from the end of the pisiform to the tip of the claw-bone supplies a size-determining factor. Taken thus, the hand measures 270 mm. in length, but this is less than actual totality by anything up to 25 mm., since the fifth is not the longest digit. In life, with claw sheaths *in situ*, this hand must have been quite 300 mm. long, by 145 to 150 mm. wide. In Tapirs, the hand always contains more digits than the foot, but in no known instance do they ever reach as high as five. In the Rhinoceroses, at least three digits enter into the composition of the pes, while the manus may retain four. The marsupials largely show a digital reduction of the pes, but, owing to the necessities for manipulating the pouch, the hand has remained intact. In the *Nototheria* the feet were obviously following the trend, but the stirp became extinct before the climax had been reached. In view of this latter fact, nothing very remarkable appears in the manal osteology; the pisiform and cuneiform supply the ulnar cup, the unciform gives articular facets to digits four and five, the magnum supports digit three, the trapezoid and trapezium carry the remaining digits. The scaphoid being mainly supported by the magnum, brings the *Nototheria* into line with the Tapirs and Perissodactyla generally.

As the ungual phalanges form a complete set, and have hitherto been undescribed, we supply a table of dimensions.

CLAW-BEARING PHALANGES OF *NOTOTHERIUM MITCHELLI.*

(Left Hand.)

Name.	Total Length mm.	Width (Basal) mm.	Girth mm.	Remarks.
Digit No. 1 ...	55	31	87	Condition perfect
Digit No. 2 ...	56	25	77	Condition perfect
Digit No. 3 ...	62	26	80	Condition perfect
Digit No. 4 ...	71	27	84	Condition perfect
Digit No. 5 ...	71	23	83	Condition perfect

THE RADIUS AND ULNA.

As neither radius nor ulna was complete in *N. tasmanicum*, no measurements could be supplied when the monograph upon that animal was compiled. With *N. mitchelli*, we get both bones from the right side, and a perfect ulna from the left, the associated radius, however, being distally imperfect. The left ulna is 437 mm. long, the right being 436 mm. The right radius is 385 mm. long. As both bones have been figured proximally (*vide* plate 10, monograph *N. tas.*), it will be only necessary to say that distally the ulna ends in a perfectly round head, 36 mm. in diameter, while the radius expands to a transverse width of 80 mm., its proximal cup being only 50 mm. x 48 mm., which is exactly the same in *N. tasmanicum.*

THE STERNUM.

Four moieties of the sternum of *N. mitchelli* were recovered with the other parts of the skeleton. These consist of the manubrium, and three sternebræ of the Gladiolus. Possibly two segments, and the ziphoid element are missing. In articulating the skeleton of *N. tasmanicum*, ten pairs of ribs were carried to the sternum, seven of which were attached to the pre and meso-sternum. This must be very close, if not actually, the condition that really obtained in these animals, and, accordingly, two sternebræ are missing from the mesosternum of *N. mitchelli*, in addition to the metasternal element. The manubrium is 100 mm. long, and 108 mm. wide; it is heavily keeled, the carina ending in a tuberosity that projects outwards for 45 mm. If this tuberosity is pressed against the vertical plate of the measuring board the total thickness of the bone is 71 mm.

The sternebræ are furnished with nearly square bodies, and expanded ends; the two perfect ones measure 75 mm. and 74 mm. respectively, in total length, with a width of 40 mm. at the ends, sinking to a central width of 28 mm. in vertical measurement, the transverse rim measurement being 26 mm. Vertically, the surfaces are convex and concave—transversely concave—on either side.

FEMUR.

The femur closely simulates that of the *Leptocerathine* group (as duly figured in plate No. eleven of the monograph of *N. tas.*), but is larger, as the appended table will show. Being a younger animal, the muscular surfaces are less strongly marked; indeed, the femur, as a whole, is a smooth one, as indicates the age stated.

FEMORA OF *MEGACERATHINE NOTOTHERIA*, AND THOSE OF THE *LEPTOCERATHINE* GROUP.

(No. 1 = *N. mitchelli*. No. 2 = *N. tasmanicum*.)

No. 1.	mm.	No. 2.	mm.
Total length	= 540	Total length	= 475
Across condyles ...	= 157	Across condyles ...	= 153
Girth below head	= 275	Girth below head	= 251
Diameter of head	= 89	Diameter of head	= 83
Girth above condyles	= 385	Girth above condyles	= 381
Girth, including condyles	= 474	Girth, including condyles	= 451
Width between two vertical walls	= 251	Width between two vertical walls ...	= 204

HUMERUS.

The left humerus is here selected from the skeleton of *N. mitchelli*, so as to fall into line with that of the monograph of *N. tasmanicum*.

COMPARATIVE HUMERI.

(No. 1 = *N. mitchelli*. No. 2 = *N. tasmanicum*.)

No. 1.	mm.	No. 2.	mm.
Total length	= 496	Total length	= 467
Ecto-tuberosity to end of pectoral ridge	= 268	Ecto-tuberosity to end of pectoral ridge	= 238
Proximal width ...	= 120	Proximal width ...	= 125
Distal width	= 175	Distal width	= 175
Least width of shaft	= 71	Least width of shaft	= 62
Thickness of radial condyle	= 57	Thickness of radial condyle	= 58
Thickness of ulnar condyle	= 60	Thickness of ulnar condyle	= 60
Width of condylar articular surface	= 132	Width of condylar articular surface	= 124

A curious relationship between the width of the distal end of the humerus, and the length of the mandibular tooth line, has been noted by De Vis in the case of Wombats, and suspected by him to extend to the *Nototheria*. If the mandibular tooth line of *N. mitchelli* is measured it will be found to be 171 mm., while the distal end of the humerus is 175 mm., as noted *supra*.

TIBIA.

The tibia of *N. mitchelli* is generically similar to that of the second group, but shows various departures from that type. The shaft upon the whole (allowing for age characters) is similar, but the articular surfaces show the variations we might expect to find in animals whose gait was dissimilar.

COMPARATIVE SIZES OF TIBIÆ, IN THE TWO GROUPS.

(No. 1 = *N. mitchelli*. No. 2 = *N. tasmanicum*.)

No. 1.	mm.	No. 2.	mm.
Total length between two vertical walls ... ... =	327	Total length between two vertical walls ... ... =	284
Greatest proximal width ... ... =	134	Greatest proximal width ... ... =	125
Greatest distal width ... ... =	92	Greatest distal width ... ... =	88
Least distal width =	66	Least distal width =	63

THE FIBULA.

If anything, the fibula of *N. mitchelli* is more bent in the shaft than that of the second group, and the articular surfaces manifest their own special characters. These need not be noted *in extenso*, as the size of the bone will serve to separate it from one of the other race.

COMPARATIVE FIBULÆ.

(No. 1 = *N. mitchelli*. No. 2 = *N. tasmanicum*.)

No. 1.	mm.	No. 2.	mm.
Total length between two vertical plates ... ... =	282	Total length between two vertical plates ... ... =	248
Greatest proximal width ... ... =	84	Greatest proximal width ... ... =	73
Least proximal width ... ... =	67	Least proximal width ... ... =	64
Greatest distal width ... ... =	59	Greatest distal width ... ... =	52
Least distal width =	49	Least distal width =	43

THE CLAVICLES.

The clavicles of *N. mitchelli* agree in outline exactly with those attributed to *Diprotodon*, and depart in contour from those of the *Leptocerathine Nototherian* group, in exactly the way noted in the monograph upon *Nototherium tasmanicum.* Owing to this variation in shape, it is not easy to give comparative contour measurements, but the following may prove useful.

COMPARATIVE CLAVICLES.

(No. 1 = *N. mitchelli.* No. 2 = *N. tasmanicum.*)

No. 1.	mm.	No. 2.	mm.
Greatest length ...	= 171	Greatest length ...	= 150
Height of arch ...	= 91	Height of arch ...	= 87
Greatest width ...	= 47	Greatest width ...	= 37
Least width	= 24	Least width	= 29

In every way the clavicles of both *Diprotodon* and *Nototherium mitchelli* are more shapely bones than those from the *Leptocerathine Nototheria.* They are wider at the acromial end of the shaft, and more slender as the shafts approach the sternal facets. Apparently this extra thinning of the shaft did not introduce an element of weakness at this point, since the broken clavicle of *N. mitchelli* snapped well above the thinnest part of the shaft. In attempting to repair this fracture, the periosteal membrane poured out enough ossific matter to increase the width of the bone by 20 mm.; at the same time it contracted its length (by altering the curve of the outline) some 13 mm.

THE SCAPULÆ.

Both scapulæ are imperfect as to length, and otherwise mutilated. This is owing to the complete exposure of the right side of the animal to wind and weather for many years—the left side being buried in the mud saved the lower part of the left scapula, the apex, however, being above the water line came in for unfair treatment. The longer of the two measures 395 mm., the complete length being most likely 450 mm. That of *N. tasmanicum* is 430 mm. in an intact specimen, so we may assume the larger animal's shoulder blade was some 20 mm. longer. The width of the nearly perfect left scapula is 253 mm. Except in the matter of age, the scapulæ agree fairly well with those figured, and described in the monograph upon *Nototherium tasmanicum* (*vide* page 23, and plate 9.) The age factor, of course, omits the superossification due to matured muscular attachment. The great fossa marked by an arrow in the picture is less strongly indicated in the younger animal—presumably, this fossa related to the infra spinalus, and teres muscles, and a second groove may relate to the scapular dorsal artery. The acromion process is 110 mm. wide, and is roughened for the enormous deltoid muscle, that ascended the spine for 245 mm., in addition to involving the whole of the distal end of the actual process.

THE PELVIS.

The pelvis of *Nototherium tasmanicum* has been duly illustrated and described (plate 15, pages 34 and 35 monograph), and this will serve the purpose of a generic description, but the comparative study we had hoped for was marred by the fragmentary character of the pelvis of *Nototherium mitchelli.* As far as the specimens serve we are safe in saying that the *Megacerathine* animal was similar to that of the *Leptocerathnie* one in the pelvic regions, and if a complete set of measurements could be supplied the former would be presumably somewhat larger than the latter. To avoid the necessity of reference, we reproduce here the scale of sizes already published.

PELVIS OF *N. TASMANICUM.*

		mm.
(1)—Total width across the slightly imperfect ilia	=	702
(2)—Greatest width of least mutilated ilium	=	235
(3)—From tuberosity of ischium to upper rim of ilium	=	535
(4)—Width of pelvis across rims of the acetabula	=	422
(5)—Transverse measurement of inlet of pelvis ...	=	172

In the pelvis of *N. mitchelli* the whole of the sacral portion is torn away, and neither of the ilia is perfect. An attempt to compare measurement No. 3 of the above table gives 500 mm. for a slightly smaller portion than is present in the pelvis of *N. tasmanicum*, thus suggesting a rather larger pelvis as a whole. For articulation purposes the pelvis of *N. mitchelli* has been now restored, and as so outlined its greatest width across the ilia is (36in.) 915 mm. This may eventually prove to be too wide, but at least 100 mm. in excess of that of *N. tasmanicum* is certainly within the mark.

COMPARATIVE SKULLS OF *NOTOTHERIA.*

At an earlier stage of this work we promised to give a table of contrasting skull characters, and although in part this has been supplied in drawing up the conspectus of either group, yet to a practical worker it will be exceedingly convenient to have a ready reference table such as that hereunder supplied.

	Megacerathine Nototheria.		*Leptocerathine Nototheria.*	
Characters.	Male.	Female.	Male.	Female.
Nasal bones	Wide and heavy, 175 mm. wide.	Not quite so heavy, 160 mm. wide.	Smaller than the female of *N. mitchelli*, total width 138 mm.	Although at present the data is too slight to give with any degree of accuracy, the future will be certain to supply this information.
Forehead and parietal regions.	Flat & wide with a parietal platform.	Similar to male, but smaller.	Small forehead, and a long parietal crest.	
Zygomatic arches.	Heavy processes not symmetrical.	As in the male.	Lighter in build, more grooved, and symmetrical.	
Nature of tusks.	Oval in outline, widely divergent, powerful.	Flatter in outline, less divergent, less powerful.	Oval in outline, widely divergent, and powerful, quite as powerful as males of the other group.	
Cranial walls	Convex to the temporal fossæ, strongly so.	As with the male.	Concave to the temporal fossæ, as strongly so as they are convex in the other group.	
Pre-massiter processes.	Bent back to molar No. 3, and blades twisted outwards.	Bent back to molar No. 3, blades twisted slightly outwards.	Bent back to molar No. 4, blades twisted inwards.	
Squamosal element of the zygomatic arch (contour line).	Leaves occiput concave, thus for a very small space, thence convex to the suture.	Leaves occiput concave, thus for a space, thence convex, and lastly nearly straight to the suture.	Leaves occiput with a big convex swelling, slopes concavo-convexo-concave, to suture.	

For other details see the text of the articles already published.

THE EXTERNAL EAR, AN OSTEOLOGICAL COMPARISON.

It is an interesting piece of parallel evolution to observe how closely the *Nototherian* ear simulates the conditions obtaining among true Rhinoceroses, and then to pass in review the skull elements out of which they have been developed. Although we have carried out this study widely enough to embrace various Rhinoceroses, space forbids the publication of more than a small portion of our data.

In the Tichorhine Rhinoceros, the meatus auditorius is formed by the post-glenoid—which is a powerful process—reaching backwards to meet a similar contribution from the mastoid, the line of junction being vertical and central. In a general way the Indian Rhinoceros repeats this set of conditions, although the true ear bones may be loose. If the photograph reproduced in plate xiii. is appealed to, it will be seen that in *Nototherium mitchelli* the loose tympanic tube of the Wombats is here strongly inset, between the backward curve of the post-glenoid and the forward sweep of the mastoid, the whole having coalesced into a single element.

Group departures from these conditions are found in the *Leptocerathine Nototheria*, not sufficiently important to detail here. (3) Now let us see how these structural moieties exist in the Wombats, and the Native Bear.

TASMANIAN WOMBAT.

There is a post-glenoid process, which is removed mesiad from the contour line of the skull, and is shorter than the mastoid process. The tympanic is tube-like, and distinct, and the par-occipital is short.

HAIRY-NOSED WOMBAT.

The post-glenoid is obsolete; the mastoid is thin and long; the tympanic is suspended mid-way between the glenoid articular wall, and the mastoid amid deeply excavated air cells.

NATIVE BEAR.

Strong post-glenoid process (deeply excavated by air cells), tympanic deeply set in a fossa between the post-glenoid and the squamoso-mastoid process, long par-occipital process.

(3.) Briefly it may be said that the ear is a stage nearer the primitive condition.

We may assume in this connection that the Wombats are nearer to the primitive marsupial than the Native Bear is, and that in the *Nototherium* the post-glenoid and mastoid enclosed the tube-like tympanic—that still remains distinct in the Wombat, but has developed a special stirpian trend in the Native Bear.

Here, then, we get a result structurally the same, in three animals widely removed as to habitat, one having ranged Europe in pleistocene time, a second living in Australia in the same age, and a third still living in the Indian zoological province. The Marsupial Rhinoceros (*Nototherium*) still shows exactly how the ear was evolved out of the elements common to more than one type of marsupial that still survives.

THE SIZE OF *NOTOTHERIUM MITCHELLI.*

It is an interesting study to try to recall the alteration in size of the animal here under consideration, that these new discoveries have forced upon our mental vision. Professor Owen allowed for a large animal, and as the female skull known to him—and so carefully studied in detail—falls little short of the male cranium in point of size, he was in this respect fairly well informed. In forehead, and nasal expansion, the male, however, exceeds the female by a full inch, and therefore his remark that in its facial parts *Nototherium* was the quaintest animal that ever lived receives additional support, since an extra inch in the dilation of an animal's nose completely changes the facial contour. The arms and legs, he assumed, were bulky, but relatively shorter than we know them to be, as note the size of the upper arm. The humerus Owen allowed for was 400 mm. long and 224 mm. wide. The real humerus is 496 mm. long and 175 mm. wide. Thus the upper arm bone was narrower by two inches, and longer by nearly four inches than was suspected of. If this ratio is carried out to all the bones of the appendicular skeleton, we are apparently dealing with an animal at least a foot taller than Professor Owen computed it to be. Even the *Leptocerathine* group of *Nototheria* were longer in their humeri by 67 mm. (2⅝ inches) than the humeri relegated to the *Nototheria* generally, and the elongation of their scapulæ to a measurement of 430 mm. (just on 17 inches) would certainly never have been guessed at.

The long narrow foot, not known to have been associated with the animal, and the excessively wide and heavily clawed hand are also new items, all of which, taken in totality, considerably alter the animal's make-up as originally visualised. Upon the other hand, the great palæontologist had his share of success, correctly associating the skull and jaws (that by reason of their apparent anomalies acted as stumbling blocks to others for more than half a century). Again, in the matter of the imperfect mandible, from South Australia, he instinctively and with unerring accuracy separated it from the type species; and seeing as in a glass darkly the real significance of the evolutionary trend he listed the nasal septum of both *Diprotodon* and *Nototherium*, in the same category with such structures in the Tichorhine Rhinoceros. As some students of Professor Owen's works upon "Extinct Mammals of Australia" appear to have missed the association of *Nototherium* with *Diprotodon*—and therefore with the Tichorhine Rhinoceros—in this matter of the nasal septum, it may be opportune to recall his actual data relating to this subject. At page 524 (part 3, Foss. Mam. Aust.) he notes the development of the nasal septum of *Diprotodon*—out of the ordinary marsupial anatomy—to the condition that obtained in the Tichorhine Rhinoceros, and again at page 51 of part 5, he links *Nototherium* with *Diprotodon* in this respect, remarking, *inter alia*, that among the marsupials these two animals stand alone. *Ipso facto*, therefore, both approached the extinct Perissodactylan Ungulate, to a greater or lesser degree. We now know that in the *Leptocerathine* group, the nasal bones and nasal septum approached each other very closely—while in the other group, the nasals receded for some 40 mm. in the male animal, but less in the female.

RECAPITULATIVE NOTES.

If the aim of our studies has been realised, we shall have to some extent convinced zoologists, and palæontologists, of the fact that the Rhinoceros was not absent from the fauna of Australia in ages past. True to the structural type of the country, these animals retained the marsupial habit, simply grafting on to it the results of that evolutionary trend that has culminated in other lands in the Perissodactylan Ungulates. Just how many groups Australia could boast of we are at present unable to say, but apparently two, at least, were well segregated at the time extinction overtook the race. One of these, the *Megacerathine* group, manifested more development along the fighting trend than the second, or *Leptocerathine* group did. This is noticeable chiefly in the alterations to the nasal bones for the attachment of the horn; the extra strengthening of the neck; the general enlargement of the whole skeleton to maintain a suitable poise; the dilation of the skull walls to provide extra air cells, to deaden shock and to combine lightness with strength. Starting (in the limbs) with pentadactyle hands and feet, and the primitive character of a fibula articulating directly with the calcaneum, they changed to a condition that was rapidly reducing the number of toes (as in the Rhinoceroses) and the fibula was slowly losing its articular grip of the calcaneum. In the *Leptocerathine* group it had absolutely done so, and in the *Megacerathine* group the articular facet was extremely reduced. The ear was being evolved to suit the new conditions of life, and in total result had reached a rhinoceros state of development, but the primitive material available to a marsupial animal being different from that which obtained in the Eocene Ungulates, the method of elaboration was quite distinctive, as duly noted above. As no *Diprotodons* have as yet been found in Tasmania we have not, by written word, attempted to speculate upon their relationship to the two groups we have had under review. Our personal views are therefore unexpressed, for the present. Students of Palæontology need not travel to the wastes of America to find remains of animals that closely simulated the Perissodactyle Ungulates, since they have in Australia, and Tasmania, the evidence of creatures that started with a primitive marsupial habit, and while unfolding that exceedingly interesting zoological form, some of them embraced, *pari passu*, the evolutionary trend that produced the Rhinoceros and Tapir stirps in other parts of the world. America is said to have elaborated seven groups of, more or less, Rhinoceros-like animals; it remains for the future to say what number actually existed in the Australian zoo-geographical province. Professor Owen first glimpsed the effect of the embracing evolutionary trend, in the year 1870. Professor Watson directly extended the idea when viewing the Tasmanian *Nototherian* remains in 1914. Early the next year, Mr. L. Glauert, of the Perth Museum, in Western Australia, expressed a tentative opinion upon the subject, after four months' work upon the fossil bones of the Mammoth Cave, but felt unable to state exactly how far the rhinoceros trend had advanced, his exact opinion (as reported at the time) being that the "*Nototherium* was a gigantic Tapir, or "Rhinoceros-like animal." In 1915, also, H. H. Scott reviewed the evidence yielded by a study of a *Leptocerathine Nototherium* (*N. tasmanicum*) in the light of its being purely a Tapir-like animal, but abandoned the view in March, 1917, in favour of that advanced by Professor Watson (*vide* Brochure No. 6, Launceston Museum Series).

The reasons for opposing the Rhinoceros habit, in *N. tasmanicum*, as also the evidence in favour of the same, in the light of information supplied by the study of the skeleton of *Nototherium mitchelli*, have been duly set out, in our Paper No. 3, and therefore need not be recalled here. As far as we know, we have fairly impartially weighed every fact of importance recorded by any and all workers, in this particular branch of Palæontology, and the final result has been the several views expressed in our short series of papers, of which the present constitutes No. 4.

For the scientific use of the skeleton of *Nototherium mitchelli*, we are indebted to Mr. K. M. Harrisson, of Smithton, who generously placed the specimens at our disposal for the purpose named. Mr. Harrisson has also presented the whole of the remains to the Tasmanian Museum, Hobart, with a view to their future exhibition at that institution. In conclusion, we may just add that the order in which the osteological evidence has been reviewed was largely determined by the condition of the material—some bones being unfit to handle for months, while others were stable at an earlier date.

ADDENDUM.

After our notes upon the nasal ossicles, found in the skulls of the *Nototheria*, were in print we discovered that similar structures had been recorded, by Prof. O. C. Marsh, as appearing in the gigantic *Dinocerata*, of Eocene, North America. Prof. Marsh published his note in 1884 (U.S. Geological Survey, monograph No. 10, page 14), and regarded the structures as being quite unique, but suggested that they had survived in a modified state in the modern artiodactyla as the pre-nasals of the genus *Sus*. Obviously, if this homology is correct, the ossicles must have been developed as a common ungulate possession prior to the divergence of the perissodactyla from the artiodactyla, as it is unlikely they were separately evolved. The parellel development of such structures in the *Nototheria* is an exceedingly interesting point, as also is the appearance of a single central ossicle in the South American Mylodon—as duly noted in our text.

The teeth of *Tinoceras stenops*, figured by Marsh at page 47 of his monograph, show a disproportion between the upper and lower premolars, that is almost similar to that obtaining in the *Nototheria*. The cusping, of course, is quite different.

EXPLANATION OF PLATES XXII.-XXIII.

The Pes and Manus of *Nototherium mitchelli.*

Plate XXII.—Left foot of *N. mitchelli.* Astragalus in position. All missing bones outlined in black. The facet for the articulation of the fibula, with the calaneum, being well shown.

Plate XXIII.—Left manus of *N. mitchelli.* This plate shows the great spread of the hand, the powerful claws, and the general conformation to the marsupial type. Some bones missing—outlines supplied in black.