The "Mika" or "Kulpi" operation of the Australian aboriginals / by T.P. Anderson Stuart.

The "MIKA" or "KULPI" OPERATION of the AUSTRALIAN ABORIGINALS.

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[With Plate VI.]

[*Read before the Royal Society of N. S. Wales, June 3, 1896.*]

It was Miklouho-Maclay who appears to have been the first to adopt the term "Mika."[1] Howitt proposes to give the name "kulpi" to the operation from the name given to the initiate among the Dierie blacks of the Cooper's Creek district.[2] The custom was first noticed by Eyre,[3] in the country around the Great Australian Bight: it practically consists in, generally at the age of puberty, cutting the lower wall of the urethra so that it is slit completely open from below, the cleft sometimes extending only half way back, sometimes the whole way back to the scrotum. The organ then is no longer a tube. Sometimes a mere perforation is made as hereafter noted.

1 Zeitschrift für Ethnologie, Bd. xii., 1880, Verhandl. p. 85.

2 Journ. Anthrop. Inst. xx., p. 85.

3 Eyre, Journals of Expeditions of Discovery into Central Australia, 1840-41, 2 vols., London, 1845.

In a paper which was for the immediate purpose of describing certain stone implements or knives used by the blacks of the Mulligan River in performing the operation, R. Etheridge, Jun., in 1890, gave an account of what had up till that time been written on the subject of this curious and interesting custom,[1] because as he said, "there still (1890) seems to be much scepticism and ignorance on the subject." I shall, therefore, but briefly refer to the operation before describing the photographs of the actual condition which it is the main purpose of this note to record and publish.

In 1879, Dr. Milne Robertson, Surgeon of the Convict Establishment in Western Australia, sent a photograph of the organs of an aboriginal, who had had the operation performed, to the Exhibition in Sydney, but this photograph is believed to have perished in the fire which destroyed the entire building and its contents. Recently Sir John Forrest, the Premier of Western Australia, at my request, caused a search to be made for the negative or a print from it, but failed to find either, and as, so far as I can ascertain, no photograph or drawing of the condition had ever been published I venture to publish two which were taken under my own superintendence.

Dr. Milne Robertson[2] describes the slitting of the urethra to be from the meatus to the middle of the organ only, in the case of the De Grey River blacks, while in the case of those living on the north side of the Murchison, the cleft extends from the meatus to the scrotum. The latter condition is identical with that of the subject of my photographs. In other cases, as in that of the blacks of the Gawler Range, the operation is a mere perforation of the lower wall of the urethra "at the base of the scrotum,"[3] that is anterior to the scrotum, in the penial portion, as is expressly

1 Notes on Australian Aboriginal Stone Weapons and Implements.—Proc. Linn. Soc. of N.S.W., 1890.

2 Report upon certain peculiar Habits and Customs of the Aborigines of Western Australia, Perth, 1879.

3 Le Souëf—see Smyth's Aborigines of Victoria, 1878, Vol. II., p. 205.

stated by Creed,[1] who gives the opening as being from one to one and a half inches long. So also Lumholz,[2] who says that the Georgina River blacks make a similar opening an inch long in the same position, and Provis[3] gives half an inch.

The incision is made with a sharp edged piece of quartz, shell, flint, or, in more recent times, glass. These fixed with resin, twine etc., into handles constitute the "mika-knives." The bleeding is stanched with sand,[4] and the edges of the wound are burnt, Lumholz says, with hot stones—perhaps, as Etheridge suggests, to cauterize them—and are kept from adhering again and healing by being kept apart with bits of stick, wood, bark, or bone inserted between them, or by being filled with clay,[5] or by being rubbed with a broad edged stone. The result is a permanent slit, cleft or opening. Stretton speaking of Leeanuwa tribe, Borroloola, Northern Territory, says that no dressing is used.[6] Palmer[7] states that amongst the Kalkadoona of Central Queensland, the urethra is said to be sometimes "taken out," that is "cut out" after the wound is healed, that is after the wounds from the operation of slitting of the urethra are healed.

The time of life at which it is done varies very much; eight days is the soonest I have seen recorded, then ten years, fourteen years, eighteen years, and lastly the man may first be the father of two or three children, and then be operated upon. In some tribes all the males are said to be operated upon, in others some are left unoperated upon. In that case sometimes the strong and able bodied are selected for operation, sometimes they are those that are left intact.

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[1] J. M. Creed—Australasian Medical Gazette, Vol. II., 1883, p. 95.

[2] Lumholz—Among Cannibals, 1870, p. 48.

[3] Police-Corporal C. Provis, speaking of the natives of Port Lincoln in Taplin's Folklore, Adelaide, 1879, p. 99.

[4] Howitt—Journ. Anthrop. Inst., XX., 1890-91.

[5] Ravencroft—Trans. Roy. Soc. S. Aust., XV., 1892, p. 121.

[6] Trans. Roy. Soc. S. Aust., XVII., 1893, p. 232.

[7] Journ. Anthrop. Inst., XX., p. 85.

As to the aim of the operation it is impossible to come to a definite conclusion. Dr. J. C. Cox,[1] says the object of the operation is "difficult to surmise." Some writers merely refer to it as an "operation," *e.g.*, the "terrible operation" of Sturt, thus involving no theory; others again regard it as a rite or ceremony merely, *e.g.* the "incredible ceremonial" of Lubbock, the "most extraordinary ceremonial" of Eyre (*loc. cit.*), the "terrible rite" of Curr.[2]

C. W. Schürmann,[3] a missionary, who appears to be the second observer to record this custom, writing of the aboriginal tribes of Port Lincoln in South Australia, says, "the object of this strange mutilation I have not been able to ascertain. In support of a practice so essentially barbarous the natives have nothing to say more than that 'it was observed by their forefathers, and must therefore be upheld by themselves,'" here apparently it is now, at all events a pure rite or ceremony. Froggatt,[4] says "the only reason I could learn for this curious mutilation is a statement of an old man, that until it was done "they were all the same dog (or other animal)," meaning I suppose that they were not really men till they had been operated upon, they were no better than dogs or other lower animals. Howitt, *(loc. cit.)* speaking of the important Dieyerie tribe in Central Australia, says that this tribe names anyone the subject of this operation "Kulpi," and that "it is only when a young man has been made kulpi that he is considered to be a "thorough man," and in this sense kulpi is the highest stage of the initiation ceremonies. A kulpi has the privilege, and he alone, of appearing before the women in a perfectly nude state. It is to the kulpis that important matters bearing on the welfare of the tribe are entrusted, and they always take precedence of the other men who are not kulpi. They hold in fact the most important positions,

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1 Proc. Linn. Soc. N. S. Wales, 1881, p. 663.

2 The Australian Race, 1886, I., p. 72.

3 Aboriginal Tribes of Port Lincoln in South Australia, Adelaide, 1846.

4 Proc. Linn. Soc. N. S. Wales, 1883, p. 652.

and powerfully influence the government of the tribe. The headman, Jalina Piramurana, in complimenting a kulpi on the satisfactory manner in which he had accomplished some mission or matter which had been entrusted to him, was accustomed also to refer to his being a kulpi. All men sent on special missions to other tribes are kulpi. It would never be even thought of to send a non-kulpi in charge, as he would not carry much weight or have such influence as a kulpi, Men often express regret that they are not kulpi, feeling some jealousy of the superior position of those who are so distinguished, for the kulpis also take precedence at the grand corroborees, where they are the principal leading dancers and also are "masters of the ceremonies" generally. The Dieri say, according to Mr. Gason, that the object of the kulpi operation is "cleanliness," and that without it no one can be a "thorough man." "

Hardman,[1] who was geologist to Forrest's Kimberley Expedition and a keen observer, says that it can hardly be considered from a Malthusian standpoint, because "every boy is so treated, and the married men have no lack of families." He thinks it may have arisen from some case of stricture, or may perhaps be "simply some ancient rite connected with Phallic worship."

Foelsche[2] says that he was told by a Mr. Lautour that he was told by the women that the men so operated upon, though not impotent, could not beget children, and so on that account were preferred, and Mr. Lautour also said that it was considered as a mark of honour. Scarcity of food has been suggested as a cause, inducing the members of the tribe to limit their families ; but, then again the custom is observed in places where food is plentiful.

Milne Robertson does not believe it is practised in order to limit population; the natives he examined were very fond of children and had abundance of food in their country. "For my own part," he says, "I am inclined to think that these operations

[1] Proc. Roy. Irish. Acad., 1881, I. (3) No. 1, p. 73.

[2] Trans. and Proc. Roy. Soc., South Australia, Vol. v., Adelaide, 1882.

were first performed to give relief in cases of inflammation of the urethra, and that this rude surgery gradually became a custom." He argues, from the occurrence of hypospadias and the mode of development of the urethra, the comparative morphology and analogy of the organs, and from the fact that so little spermatic fluid is required to impregnate, that the operation is not really effective and is not really practised for the purpose of limiting reproduction.

Miklouho-Maclay[1] says that his correspondent, Herr Rotsh, told him that on the Herbert River the aborigines told him it was in order not to have too many children, and this is supported by another custom there, the pulling out of the nipples of young women. Sometimes the nipples are cut off so that if a child is born it shall not be suckled and will die, for they have none of the artificial means of feeding infants that we have.

The subject of my photograph was from the spinifex district of North Australia. I show you whole length photographs of him, that prove him to be a strong well-made, lusty fellow. The great cuts on the outer sides of the thighs and the tatooing of the abdomen, breast, shoulders and arms prove him to be one of a very savage and barbarous tribe. He was a difficult subject, and I was obliged to have two photographs of his genitalia made in order to show the condition fully. It is seen that we have here the result of the operation in its fullest extent, the cleft extending right up to the front of the base of the scrotum, where the round opening seen is that of the urethra. The urethra in front of this is widely opened, and it is not even a groove, for the corpora cavernosa project so that instead of being concave the urethral roof is actually convex. In the photograph, where the man himself is holding the organ, it is seen that the skin edges are pulled away to the side and the urethral surface is thus enormously extended: in the other photograph, where I am holding the organ in a suitable position to show the glans, the wrinkling of the urethral mucosa, due to its being so extended, is clearly seen.

1 Zeitschrift für Ethnologie, Bd. xiv., 1882, p. 27.

The prepuce was intact, there having been no preliminary circumcision as sometimes occurs. The exposed urethral mucosa had the bluish, injected, hardened appearance common to mucous membrane in such circumstances. The man had a considerably urinous odour, in fact he was anything but a pleasant companion to the photographer! That is not difficult to understand, when we think of the amount of wetting of the parts adjacent to the orifice which must almost necessarily happen at each micturition, and of the fact that in Sydney he was not so lightly clad as he would most likely be on his native heath. As to the actual manner in which micturition is performed Miklouho-Maclay[1] says that it is in an upright position, the organ being raised by the hand and the legs widely separated.

As to the origin of the custom we can now only surmise, but these possibilities suggest themselves, viz.—1 Quite certainly hypospadiacs would be met amongst the aboriginals, who would not, and could not fail to notice the condition. May not some aboriginal naturalists and philosophers have noted that, when the malformation did not actually prevent copulation, the seminal fluid escaped to an unusual extent, and that such unions were followed by unusually few children? This of course raises the crucial point *is* the Mika operation associated with limited reproduction? Before discussing this I shall note the other possibilities.

2. What is more likely than that in such a life as that of the aborigines, wounds and lacerations of the urethra should occur, be badly tended and in the end lead to permanent fistulas more or less extensive, or do not often fistulous openings result from disease of these regions? Dr. Milne Robertson suggests that rude surgery for the relief of inflammation may have formed the starting point. Here again, the aboriginal observer would come in, for he might be supposed to notice the escape of spermatic fluid through the opening.

3. May there not have been a deliberate and well reasoned out operation undertaken for the express purpose of letting the fluid

[1] *Loc. cit.*, Band XII., p. 86.

escape? This seems to me quite probable, for we know in very many ways that the aboriginals ascribe to the fluid the most wonderful life-giving qualities, and they are quite capable of such reasoning. Moreover, there is direct evidence of the validity of this suggestion, for I have often been told by pioneers and others that the aboriginal women deliberately empty the vagina after coition, with the view of preventing inpregnation. The power of the fluid to impregnate is thus clearly recognised.

If the custom is not to be considered as a mere rite, the question of utility or effect must be discussed. The statements of the blacks themselves, as we have seen, do not permit of any certain conclusion to be drawn. White observers, too, give unsatisfactory accounts, some say that it really limits production, some that the children are just as numerous, some make no remark on that head at all.

Miklouho Maclay's informant Mr. B—— told him that he had actually seen the fluid escape *in coitû*, and this is indeed what one would expect from the state of the parts. Milne Robertson argues that the edges of the groove will be brought together *in coitû*, and so a sort of temporary channel be established as in birds. Contemplation of the subject of these photographs leads me to the opposite conclusion; it seems to me, rather, that the bulging corpora cavernosa will open the urethral groove wider and wider. Indeed is is wholly misleading to compare the natural corpus spongiosum of birds to the mutilated spongy body of these men. I believe, then, that the condition does prevent the entrance of the full charge of the fluid. This, however, does not imply absolute sterility, for it is of course well known that an extremely small quantity of the spermatic fluid is necessary to fecundation. It is also known that if the fluid merely bathe or touch the external parts the spermatozoa can make their way up the whole length of the passage by their own motion and so effect fecundation. But in the mika condition the base of the intromittent organ and the pudenda will be so bathed in the fluid that the movements of the parts will certainly smear the lower part of

the vagina with it. Further, we are told, and it is certainly the case in the subject of my photograph, that the release of the corpora cavernosa below permits the organ to be flattened and widened, especially during erection. This will itself tend to widen the vaginal orifice and so permit the fluid to enter more easily. Thus while the imperfection of the tube prevents all the fluid being lodged well within the passage, a quantity will certainly be left within the lower part of it. In my opinion therefore, it is a question of degree—in the normal condition a large quantity is left in the passage, in the mika condition it is a small quantity.

What then is the probable effect of this diminution of the quantity of fluid introduced? I think there will generally be upon the whole, lessened chance of fecundation, but in particular cases it *may* not be very marked at all, and the recorded observations as to the number of children in the camps of mika-practising tribes support this view, which, however, is opposed to the opinions expressed by many writers. Creed,[1] for instance, regards the mika as the "most perfect form of "Malthusianism practicable," and says that "impregnation is impossible, and this effect seems to be the desired end for which the operation is performed." Eyre however, who first described the condition, does not go so far as that. He says, "this extraordinary and inexplicable custom must have a great *tendency* to prevent the rapid increase of population, and its adoption may perhaps be a wise ordination of Providence for that purpose, in a country of so desert and arid a character as that which these people occupy."

Taking everything into consideration, I conclude that—

(1) Nothing whatever can be definitely stated as to the origin of the custom.

(2) The operation does not necessarily render the man sterile. It merely diminishes his fertility; what the degree of diminution may be will depend entirely on circumstances.

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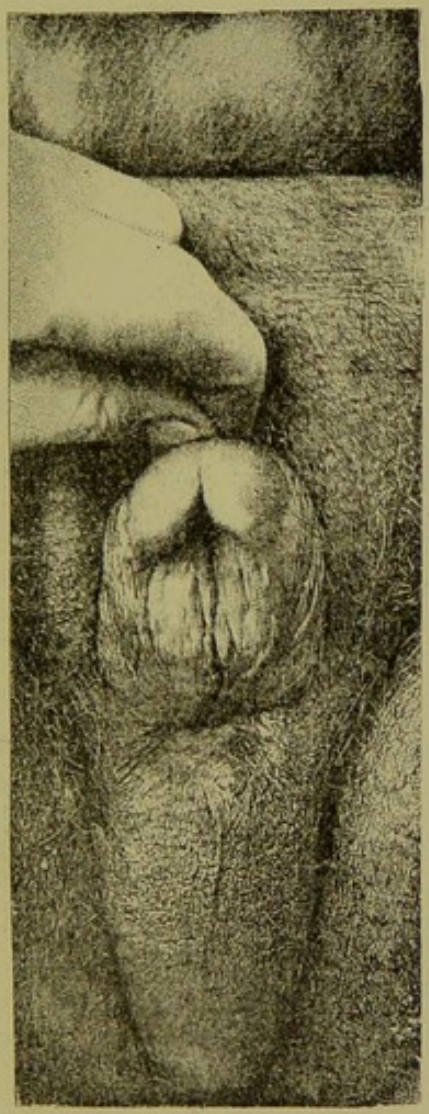
[1] *Loc. cit.*, p. 95.



[*From the Proceedings of the Linnean Society of New South Wales 1898, Part 1, April 27th.*]

ON THE AFFINITIES AND HABITS OF *THYLACOLEO.*

By R. Broom, M.D., B.Sc.

The nature of few fossil animals has been more discussed than that of the remarkable extinct Australian form to which Owen gave the name of *Thylacoleo carnifex.* Not only has there been considerable difference of opinion as to the affinities of the animal, but its probable habits have been even more debated.

The first important paper on *Thylacoleo* was published by Owen in 1859.* In this paper are described the greater part of the posterior half of the skull, a fragment of the maxilla, and the main part of the ramus of the lower jaw. From the examination of the foramina at the base of the skull, together with one or two other characters, Owen was led to conclude that the remains were those of a Marsupial, while from the characters of the temporal fossæ, occiput, and especially from the rudimentary condition of the molars, together with the enormously large and cutting premolars, which bore a considerable superficial resemblance to those of the cat tribe, he was further led to the conclusion that the form had been a carnivore, and "one of the fellest and most destructive of predatory beasts."† His views of its affinities at this time probably were that it had its nearest relatives in the *Dasyuridæ*, bearing apparently a somewhat similar relationship to the existing carnivorous forms that the lion does to the dog. At this time there was no evidence as to whether the large tooth in the front of the jaw, indicated only by the socket, was a canine

* On the Fossil Mammals of Australia. Part i. Description of a mutilated Skull of a large Marsupial Carnivore (*Thylacoleo carnifex*, Owen) from a calcareous conglomerate stratum, eighty miles S.W. of Melbourne, Vic. Phil. Trans. Vol. 149, 1859.

† *Loc. cit.* p. 319.

or a terminal incisor, and though Owen inclined to regard it as a canine, he admits the possibility of its being an incisor, in which case he recognised that the affinities would be more with the Diprotodonts, for he adds:—"If, however, this be really the foremost tooth of the jaw it would be one of a pair of terminal incisors according to the marsupial type exhibited by the *Macropodidæ* and the *Phalangistidæ*."*

In 1866, through receiving further material from Australia, Owen† was enabled to describe the greater part of the skull and of the lower jaw, and to indicate fully the nature of the dentition. It was now clearly shown that the large anterior teeth were incisors which in Owen's opinion "proved the *Thylacoleo* to be the carnivorous modification of the more common and characteristic type of Australian Marsupials, having the incisors of the lower jaw reduced to a pair of large, more or less procumbent and approximate, conical teeth or 'tusks.'"‡ Not only did the additional evidence confirm him in his opinion that *Thylacoleo* was a carnivore, but he considers that in this extinct form we have "the simplest and most effective dental machinery for predatory life and carnivorous diet known in the Mammalian class. It is the extreme modification, to this end, of the Diprotodont type of Marsupialia."§ Beyond admitting its affinities with the Diprotodonts he does not seem to have regarded it as a near relative of any of the existing groups. But from his statements in the article on Palæontology in the Encyclopædia Britannica, 8th Edition, 1859, he apparently regarded *Thylacoleo* as related to *Plagiaulax*.

In 1868, Flower read a paper before the Geological Society of London—"On the Affinities and probable Habits of the Extinct

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* *Loc. cit.* p. 318. [See also a later paper, Vol. 174, Pt. ii. 1883, pp. 576-577.—Ed.]

† On the Fossil Mammals of Australia. Part ii. Description of an almost entire Skull of *Thylacoleo carnifex*, Owen, from a fresh-water deposit, Darling Downs, Queensland. Phil. Trans. 1866, clvi. p. 73.

‡ *Loc. cit.* p. 80.

§ *Loc. cit.* p. 81.

Australian Marsupial, *Thylacoleo carnifex*, Owen."* In this paper, while agreeing with Owen's opinion that *Thylacoleo* is more nearly allied to the Diprotodonts than to the existing carnivorous forms, he altogether differs from Owen's conclusion that the animal was a carnivore. While the large premolar had struck Owen as being closely paralleled by the last premolar in the lion, Flower is more impressed by its resemblance to the homologous tooth in the Rat-kangaroo. The latter author considers that it can be "easily shown" "that the resemblance of the great premolar of *Thylacoleo* to the 'carnassial' of the true Carnivora is merely superficial."† "Indeed," he adds, "there is no tooth, either in the upper or lower jaw, of any of the Thylacines, Dasyures, or Opossums, that can be with any reason compared with them [the teeth of *Thylacoleo*]. When, however, we pass to another group of the same sub-class, the Hypsiprymni or Rat-kangaroos, we see at once in the great cutting premolar a miniature of that of *Thylacoleo*."‡ In support of this view he points out the main features of the tooth in the Rat-kangaroos and the marked degree of variability. He then considers the other teeth, and concludes that "in the number and arrangement of these teeth . . . *Thylacoleo* corresponds exactly with the modern families *Macropodidæ* and *Phalangistidæ*, and differs completely from the carnivorous marsupials."§ The remarkable reduction of the true molars, he considers, "is evidently in relation with the excessive development of the great trenchant premolar,"‖ and he points out that there is a tendency to reduction of the true molars in the Rat-kangaroos. The small size of the brain cavity and the great development of the temporal ridges he considers to be "probably only a difference of the kind always

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* Q.J.G.S. 1868, p. 307.

† *Loc. cit.* p. 309.

‡ *Loc. cit.* p. 310.

§ *Loc. cit.* p. 311.

‖ *Loc. cit.* p. 311.

observable in comparing large with small species of a natural group."* Having dealt with its affinities, Flower proceeds to consider the probable habits of this animal which Owen had supposed to be a sort of pouched-lion. Towards the solution of this question he propounds the following proposition which he thinks will be generally accepted:—"That if all the known species of a large group of animals with teeth formed on one peculiar type lead lives peaceable and inoffensive to their neighbours, and feed mainly on vegetable substances, the probabilities, in the case of any newly discovered species having teeth constructed on the same general type, are greatly in favour of its having possessed similar habits and been nourished by a corresponding diet."† Assuming this proposition to be correct, he has no difficulty, after having settled its affinities, in concluding that *Thylacoleo* was a vegetable feeder, and he considers that there is no reason why the large premolar should not have been "as well adapted for chopping up succulent roots and vegetables as for dividing the nutritive fibres of animal prey."‡ He also states the food of *Thylacoleo* "may have been some kind of root or bulb; it may have been fruit; it may have been flesh" §; but he does not consider that the organisation of the animal suited it for preying on the large Diprotodonts.

Some years before the publication of Flower's paper, Falconer,‖ in dealing with the probable habits of *Plagiaulax*, which Owen had regarded as a carnivorous form, set forth a number of arguments in favour of its being a herbivore, very similar to those which Flower has applied to *Thylacoleo*, so that though Falconer apparently agreed with Owen as to the habits of *Thylacoleo*, his various arguments if applied would more logically make him a supporter of Flower's position.

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* *Loc. cit.* p. 311.

† *Loc. cit.* p. 315.

‡ *Loc. cit.* p. 318.

§ *Loc. cit.* p. 318.

‖ "On the disputed affinity of the Mammalian Genus, *Plagiaulax*, from the Purbeck Beds." Q.J.G.S. 1862, xviii. p. 384.

Gerard Krefft,* formerly Curator of the Australian Museum, Sydney, published in the same year as Flower dealt with this subject, a short note in the Annals and Magazine of Natural History, in which he states his belief that *Thylacoleo* was "not much more carnivorous than the Phalangers of the present time."†

To his various opponents Owen‡ replied in a lengthy paper in the Philosophical Transactions for 1871. Flower and Falconer both found their conclusions largely on the fact that a diprotodont dentition is among living Marsupials and in most Eutheria met with only in herbivorous forms; Owen's position on the other hand is mainly founded on Cuvier's principle that the molar teeth always indicate whether an animal has been herbivorous or carnivorous, and he holds that in the teeth of *Thylacoleo* we have "no molar machinery for the mastication of vegetable food, but a maximised modification of the teeth for the division of fleshy fibre, and so much of the tubercular form added for the final crush or squeeze of gristle or other tough part escaping the shears, as exists in the most carnivorous of placental mammals."§ With the view that *Thylacoleo* was a pure carnivore, he holds that all the other parts of the dental set are in complete harmony—the sharp incisors being here constructed "to pierce, retain, and kill," and thus performing the functions of the more usual canines. That a diprotodont dentition can be modified to suit the requirements of a carnivorous animal Owen brings forward quite a series of forms to show. The low position of the condyle and its shape are, he holds, additional evidences in favour of carnivority. Having discussed the various arguments in favour of *Thylacoleo* being a herbivore, he proceeds to deal with the affinities of the form and concludes that it is moderately

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* "On the Dentition of *Thylacoleo carnifex*." Ann. & Mag. Nat. Hist. 1866, (3), xviii. p. 148.

† *Loc. cit.* p. 149.

‡ On the Fossil Mammals of Australia. Part iv. Dentition and Mandible of *Thylacoleo carnifex*, with remarks on the arguments for its Herbivority. Phil. Trans. Vol. 161, 1871, p. 213.

§ *Loc. cit.* p. 228.

nearly allied to *Plagiaulax* and considerably removed from existing Diprotodonts.

In 1872 Krefft* communicated a second short paper to the Annals & Magazine of Natural History, in which he agrees in the main with Flower's position. In this paper he records his opinion "that the animal under discussion is a mixed feeder allied to the phalanger tribe."† But he appears to have been slightly in doubt as to the habits, for he states that "with the true molars reduced to a pair below, one of which is tubercular, and to a single transverse tooth above, the somewhat carnivorous character of the animal becomes manifest;"‡ while further on in the same paper he speaks of *Thylacoleo* as a "certainly harmless creature,"§ and in a paper published a year later,‖ he says,—"the view I took first of the herbivorous habits of the 'lion in phalanger hide' was a perfectly correct one."¶

Since then, beyond a short paper by Owen** in 1887, in which he describes the posterior part of a perfect jaw, I am not aware of any special papers having been published on the subject, but numerous short notes have appeared by various scientists in different publications.†† Flower's article on Mammalia in the 9th

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* "A Cuvierian Principle in Palæontology tested by evidences of an Extinct Leonine Marsupial (*Thylacoleo carnifex*), by Professor Owen, F.R.S." Reviewed by Gerard Krefft. Ann. & Mag. Nat. Hist. 1872, (4), x. p. 169.

† *Loc. cit.* p. 175. ‡ *Loc. cit.* p. 174. § *Loc. cit.* p. 181.

‖ "Australian Natural History." Trans. Roy. Soc. N.S.W. 1873, p. 135.

¶ *Loc. cit.* p. 138.

** "Additional Evidence of the Affinities of the Extinct Marsupial Quadruped, *Thylacoleo carnifex*, Owen." Phil. Trans. 1887, B.

†† [It seems desirable to mention that when this paper was written the author was resident in Namaqualand, Cape Colony, quite out of reach of libraries. Otherwise no doubt some special reference would have been made to two papers by Mr. De Vis, of the Queensland Museum, in which the carnivorous (ossiphagous) character of *Thylacoleo* is upheld ("On Tooth-marked Bones of Extinct Marsupials," P.L.S.N.S.W. 1883, viii. p. 187; and "On a Femur probably of *Thylacoleo*," Proc. Roy. Soc. Queensland, 1886, iii. p. 122). Two later papers by Prof. Owen ("On the Affinities of *Thylacoleo* and on the "Pelvic Characters of *Thylacoleo carnifex*," Phil. Trans. Vol. 174, Part ii. 1880, pp. 575 and 639) have also been inadvertently overlooked.--Ed.]

Edition of the Encyclopædia Britannica, 1883, shows that he still maintains his early opinion. And in more recent times Flower's position has received the support of one of our most distinguished palæontologists, Mr. R. Lydekker.*

Whatever difference of opinion may still exist as to the habits of *Thylacoleo* from what is now known of its structure, its affinities can be made out with tolerable certainty. The structure of the lower jaw and the dentition render it manifest that the form is more nearly related to the Phalangers than to any other living group, and there are none of the cranial characters but are quite in harmony with this conclusion. In none of the living Phalangers is there a similar enlargement of the posterior premolar, but in the *Macropodidæ* which have manifestly been an offshoot from the Phalangers, the enlarged premolar has been retained in many of the forms—especially the smaller Rat-kangaroos. About three years ago I discovered in a bone breccia deposit near the Wombeyan Caves, N.S.W., the remains of an interesting little Marsupial, which I described in a paper communicated to this Society,† under the name of *Burramys parvus*. This little form, which is evidently the representative of a sub-family of the *Phalangeridæ*, and to which the name *Burramyinæ* may be given, in most of its characters agrees with the Phalangers, but it possesses the greatly enlarged and grooved premolars of the Rat-kangaroos; and it will be observed that not only does it show the evidence of a group which fills the only remaining gap between the Kangaroos and the Phalangers, but as a Phalanger with the posterior premolars enormously enlarged it comes nearer to *Thylacoleo* than does any extinct or living form hitherto discovered.

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* Manual of Palæontology by Nicholson & Lydekker, Vol. ii, 1889. Also Royal Natural History, Vol. iii. 1894, p. 264.

† "On a small fossil (Diprotodont) Marsupial, with large grooved Premolars." P.L.S.N.S.W. 1895, p. 563. Also "Report on a Bone Breccia Deposit near the Wombeyan Caves, N.S.W.; with Descriptions of some new fossil Marsupials." P.L.S.N.S.W. 1896, p. 48.

Before, however, discussing the relations and habits of *Thylacoleo* it may be well to make a short digression to consider the origin and probable phylogenetic history of the enlarged premolar as found in *Burramys* and carried on into the *Macropodidæ*. Though grooved premolars occur in the *Plagiaulacidæ* it will be unnecessary at present to discuss that group, as it is certainly not nearly related to the existing Diprotodont Marsupials, and any similar development can only have been due to a parallel development.

Let us imagine a small Dromicia-like Phalanger which, from necessity, had to live less exclusively on succulent leaves and other soft substances and had to make up the deficiency with grass. Eucalyptus and other succulent leaves, fruits, and even insects, can be broken and crushed, but grass requires to be cut, and the comparatively feeble and pointed incisors would unaided be unable satisfactorily to finely cut the tougher fibres of the new diet. The sharp-edged premolars would be called in to assist in the dividing process and the increased work given to them would lead to their greater development. It is further not difficult to see the advantage that would result from a serrated edge being acquired, though the exact details by which the serrations would arise could not well, with the meagreness of the data, be more than roughly guessed at. Such a development and specialisation of the posterior premolar would give rise to a form closely resembling *Burramys*. In the Macropod line of descendants the arboreal life is more or less completely abandoned, and the whole organisation has been modified to suit a ground life and a diet of grass and other fibrous plants and roots. The lower limbs have become lengthened and strengthened to enable the animals to escape their enemies by flight; and the hallux or "thumb" being a useless encumbrance, no longer required for grasping the boughs, has been early lost. In only one species of the *Macropodidæ (Hypsiprymnodon moschatus)* does the hallux still remain, apparently an ancestral type and one which forms an almost perfect link between the Burramys-like species and the Rat-kangaroo. The few forms which have returned to an arboreal life, such as

Dendrolagus, cannot regain the lost "thumb," and are at most slightly modified Wallabies. All the known Rat-kangaroos—which are, there is little doubt, the more primitive members of the group*—are of small size, and their dentition is invariably suited to a fibrous vegetable diet, principally of grass. Though in *Burramys* there are but three molars above, and the fourth below rudimentary, there can be no doubt that in closely related forms the normal number was present, and the changes which would be required to give rise to such a dentition as is met with in the Rat-kangaroos from a Burramys-like ancestor are very slight. The increased grinding work entailed by the tougher vegetable diet would lead to the retention and greater development of the four molars; and while the large cutting premolars would be also retained and modified slightly to suit the special requirements of the various species, the rudimentary premolars being functionless would become lost. In the further development of the *Macropodidæ* which gave rise to the Kangaroos and Wallabies a most interesting change has taken place. Owing to the increase in size of the forms and also to the loose mode of attachment of the jaws to each other, the cutting functions can all be performed by the incisors, and the large premolars which had been functional in the lower forms became much reduced in size, and in the larger species are of so little importance that they are lost shortly after the animal becomes adult without apparently causing any inconvenience. It will thus be seen that there are fairly good reasons for believing that the unusually large development of the last premolar has been brought about in connection with the more

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* The position of *Triclis*, De Vis, is uncertain. Lydekker says of it (Palæontology by Nicholson & Lydekker, Vol. ii. p. 1286), "there is a minute tooth behind the lower incisor corresponding to the tooth in the *Phalangeridæ*, commonly reckoned as the representative of the canine [2nd incisor—Thomas]." If this observation be correct it is certainly an interesting Phalangeroid character, but De Vis informs me that the dentition in the adult jaw is "I^1; C^0; P^4; $M^{1, 2, 3, 4}$." It will thus for the present be safer to omit consideration of this form.

fibrous vegetable diet partaken of by those descendants from the Phalangers which had more or less abandoned an arboreal life.

Before considering the relations of *Thylacoleo* to this line of forms with the enlarged premolars it will be necessary to look at the much discussed question of the habits of the animal. Owen has pointed out that in the large sharp-pointed incisors, together with the powerful cutting premolars, we have a dental machinery very similar to that found in the cat tribe—the large incisors taking the place of the carnivore canines—"to pierce, retain and kill"; and that such a dental machinery, though well adapted for a carnivorous diet, would be quite unsuitable for any other; and he has further shown that the structure of the jaw and the cranium confirms the conclusion arrived at from a consideration of the dentition. The main argument of Falconer, Flower, Krefft, and Lydekker on the other hand in favour of *Thylacoleo* being a herbivorous form is that practically all known Diprotodont Marsupials are herbivorous, or mainly herbivorous, and that as *Thylacoleo* is a Diprotodont it most probably likewise had mainly a vegetable diet. That this does not unfairly represent the position will be seen from the proposition of Flower's already quoted, and from the following extract from Lydekker*:—"In originally describing this remarkable animal from fragments of jaws containing the fourth premolar, Sir Richard Owen came to the conclusion that the structure of this tooth indicated a carnivorous animal adapted to prey upon the huge Diprotodons and Nototheres; but the discovery of the complete skull has shown that the animal was more closely allied to the existing Phalangers, and that it could not have possessed the destructive habits attributed to it by its describer, though it is quite possible that its diet may have included the smaller mammals, birds, and eggs." Apart from the exception which may be taken to the reasoning involved in this statement, it in my opinion somewhat misrepresents Owen's

* Manual of Palæontology by Nicholson & Lydekker, 3rd Ed. Vol. ii. 1889, p. 1285.

position, for even in his very first paper he admits the possibility of *Thylacoleo* being allied to the Phalangers, and when more perfect specimens were discovered which proved it to be so, it in no way altered his opinion that *Thylacoleo* was nevertheless a carnivorous animal.

Let us consider, however, whether there is really such a great improbability, as Falconer and Flower seem to think, in a Diprotodont Marsupial becoming a carnivore, that *Thylacoleo* may with such confidence be referred to the vegetable feeders. The question divides itself into two—(1) whether the diprotodont dentition can be modified to suit a carnivorous diet, and (2) whether in a group of animals in a which a certain type of dentition is universal and the habits apparently uniform, an aberrant form may be met with which puts the same type of dentition to quite a different use.

Though Falconer and Flower have inclined to the view that a carnivorous animal to be able satisfactorily to kill its prey requires canines separated by a row of incisors, the large series of forms given by Owen which are carnivorous and yet have the functions of the canines entirely performed by large incisors sufficiently answers the first question. Flower, however, qualifies his statement by defining a "true predaceous carnivorous animal" as "one which kills and eats creatures at all comparable to itself in bulk and capable of making any effectual resistance."* Were this to be accepted as the definition of a carnivorous animal it would rather complicate matters, for the fish-eating Seals would have to be excluded, and so also would many of our most typical carnivores which habitually feed on small forms. There is no doubt that Owen is right in regarding the Hedgehog as more or less a carnivorous form whose organisation is sufficiently adapted to enable it to kill and eat young rabbits, and if we can thus have a diprotodont dentition which can be satisfactorily used in the killing and eating of small animals all our knowledge of the working of Nature would lead us to believe that she could in an

* *Loc. cit.* p. 317.

animal which had become exclusively carnivorous perfect the same type of dentition for an exclusively carnivorous diet.

The second question arises out of Flower's proposition already quoted. In considering it there is one important fact that must not be overlooked, namely, that while among large herbivorous animals many parts of the organisation become so highly specialised to suit the vegetable diet that it would be impossible for the animal to alter its diet very materially and thrive, in small animals the specialisation is much less marked, and a considerable variety of diet is possible. Thus, while it would be impossible for an ox or a kangaroo to become a carnivorous animal, many of the smaller Rodents and some of the small Phalangers which are normally herbivorous occasionally take to eating flesh, and a number of the small Phalangers are partly insectivorous. The Bandicoots afford a well known instance of a group of animals which are partly herbivorous and partly insectivorous; and among the Insectivora other instances occur. *Macroscelides*, the Elephant-shrew, has a jaw which judging by analogy would certainly be referred to a herbivorous form and the molar teeth would seem to be quite in harmony with this determination, and yet though *Macroscelides* is largely a vegetable feeder I have found in the stomach abundant remains of ants and even of fairly large beetles. But perhaps in no Order is there a more remarkable instance of change of diet than in the Chiroptera. Had *Pteropus* been first discovered as a fossil it would, according to the reasoning of Falconer and Flower, almost certainly have been regarded as an insectivorous or carnivorous form. Here we have a form, it would be held, closely allied to the insectivorous bats and having a very similar type of dentition—large canines separated by a row of small incisors—almost exactly as in the normal carnivorous types and quite unlike that found in the normal vegetable feeders, and the conclusion would be arrived at that *Pteropus* was either an insectivore or a carnivore, but most probably not a vegetable feeder. And yet the conclusion would be wrong. But were Cuvier's principle taken as the guide only a correct conclusion could be arrived at.

It is remarkable that the structure of the molars in *Thylacoleo* has been so lightly passed over by those supporting the herbivorous hypothesis. Flower and Lydekker evidently consider that the molars have been reduced through their functions being taken up by the large premolars. But could the large premolars take up the molar function—could they grind? Even those who favour the idea of *Thylacoleo* being a vegetable feeder admit that the premolars were cutting teeth, and the difficulty of imagining a herbivorous animal without grinders is got over by supposing that its food was of a soft or succulent nature. Flower thinks the food "may have been some kind of root or bulb; it may have been fruit," he says, or "it may have been flesh"; while Lydekker, though he believes the main diet to have been of a vegetable nature, thinks it may have included "the smaller mammals, birds and eggs." Though so many alternative diets have been suggested as possible, Flower presumes with Lydekker that *Thylacoleo* was a vegetable feeder, and I take it that neither believes *Thylacoleo* to have been a regular omnivorous animal feeding regularly on succulent roots, fruits, mammals, birds and eggs, but rather that succulent vegetables and fruit formed the staple diet and that animal food was partaken of only exceptionally.

For *Thylacoleo* to have lived on succulent roots and bulbs, the vegetation of the portion of Australia which it inhabited must have been very different in character from that now prevailing; and this is what Flower assumes. Though, however, this is possible, it must be admitted that as yet there is no palæontological evidence of any such radical change in the flora as will parallel that in the fauna.

But there are insuperable difficulties in the way of considering *Thylacoleo* a bulb- or fruit-eater. With its remarkable dentition the animal would be unable to do more than slice its fruits and vegetables even if it could have procured both in abundance, which is so exceedingly improbable. Now, it can hardly be denied that no mammal would be able to digest vegetables, bulbs

or fruits swallowed in slices, unless perhaps when the fruits were drop ripe. But apart from the difficulty that fruits are only ripe at one or occasionally at two seasons of the year, unless we are also to assume the very improbable condition of there being no parrots, parrakeets, cockatoos or flying foxes, there would be very little chance of the fruit ever being allowed to become drop ripe. With succulent roots and bulbs the same difficulty arises as with the fruits, that even the most succulent, if we could suppose them digestible in slices, cannot be had in a succulent condition all the year round.

With regard to the suggestion that "small mammals, birds, and eggs" may have formed part of the diet, it depends considerably on what size of birds and mammals is meant, whether such can be regarded as possible. There are no birds in Australia which *Thylacoleo* would have been at all likely to capture, except perhaps the large flightless Emus and Cassowaries, and even if other small flightless sorts existed, which is exceedingly improbable with Thylacines, Sarcophiles and Dasyures prowling about, they could not have been numerous or lasted long; while if the Emus and other allied forms were eaten surely *Thylacoleo* must be regarded as a carnivorous animal. As for mammals, we are fortunately not in ignorance of the smaller sorts that were contemporaries of the *Thylacoleo*, and we find that though many of the species were different the general character of the fauna differed but little from that found to-day. Ring-tailed and Dormouse Phalangers were common, as was also a small form allied to the flying Phalanger; while of the forms frequenting the ground the commonest were Rat-kangaroos, Bandicoots and Rats; and the only other small Mammal that was common was the small pouched-mouse. Whatever were the habits of *Thylacoleo*, it may be regarded as practically certain that it could not have caught any of the arboreal forms, and of the ground-living small mammals the Bandicoots alone might possibly have been captured. But then only an animal that was a regular carnivore would be likely to kill or able to devour a Bandicoot. The close resemblance of the general character of the smaller fauna to that present to-day

would lead us, moreover, to believe that there has probably been no great change in the flora.

It is probably, however, unnecessary to discuss further what food *Thylacoleo* could possibly have obtained, when we have, as I hold with Owen, the most satisfactory proof from its anatomical structure as to what food it did obtain. It must be admitted that *Thylacoleo* had enormous temporal muscles, and it is perfectly certain that such muscles would not have been developed unless the animal required them. For what could such powerful muscles be required? Most certainly not for slicing fruits or succulent roots and bulbs, nor would they be required even for the slicing of fleshy fibres. Temporal muscles are chiefly used apparently for closing the jaws more or less forcibly from the open position, while for the more complicated movements of mastication it is the masseter and pterygoid muscles that are chiefly used. Hence in all carnivorous animals the temporals are largely developed and the masseters more feebly, because the killing process requires a very forcible closing of the jaws, and the work to be done by the premolars and molars is comparatively little. In herbivorous animals the conditions are reversed. The jaws are here rarely required to be opened widely or to be closed with any great force, while a very large amount of grinding work has to be done, hence the temporals are rarely much larger than the masseters and often very much smaller. When we look at *Thylacoleo* we find not only the enormous temporals and only moderate masseters, but everything else about the skull seems to be built on carnivorous lines. Owen has shown the wonderful similarity which exists between the molar machinery in *Thylacoleo* and the lion, and it is hard to conceive as possible any other cause giving rise to such a specialisation in *Thylacoleo* than that which led to a similar specialisation in the cat tribe. Another most striking feature is to be seen in the condition of the incisors. Leaving out of consideration the mode of implantation and structure of the teeth—both confirmatory of the carnivorous hypothesis—there is one point which appears to me absolutely conclusive on the subject. Unless Owen's figures are altogether

unreliable, the lower incisors are quite unlike those of the herbivorous Diprotodonts. In such typical forms as the Wombat, the Koala, the Kangaroo, and the Phalanger, though there are different modifications of the arrangement, we have the lower incisors meeting the upper and forming with them an instrument for biting through a moderately tough fibrous tissue, and even in the very small Diprotodonts, so far as I am aware, the lower incisors always meet and work against the upper. But in *Thylacoleo* we have powerful pointed incisors which do not meet, but overlap. Though technically incisors they are not intended to incise, but to pierce and tear. Such powerful pointed and overlapping teeth, though easily explained on the theory that they were intended to kill and tear animal prey, were never surely provided merely to pierce succulent vegetables or ripe fruit. It might of course be argued that the incisors were used as weapons of defence, as apparently are the canines in the Baboon; but against this idea is the objection that the incisors were put to some use which wore them down and blunted them more rapidly than would be the case if they were chiefly used on the rare occasions when the animal had to defend itself, and furthermore were such the case the temporals would not require to be greatly developed.

There is thus, in my opinion, no other conclusion tenable than that *Thylacoleo* was a purely carnivorous animal and one which would be quite able to, and probably did, kill animals as large as or larger than itself.

Let us now consider how such a huge carnivorous animal might be developed from an herbivorous Diprotodont Phalanger. Though *Burramys* comes nearer to *Thylacoleo* than does any other known form, it could not itself have been a direct ancestor for the following reasons. In the masseteric fossa of *Thylacoleo* is a small foramen which opens through to the inner side of the jaw. In most of the living Phalangers this is lost, though it is still retained in *Petaurus*, and becomes enormously enlarged in the *Macropodidæ*. In *Burramys* it is also lost, and it seems very improbable that when once lost it could be reproduced in a descendant.

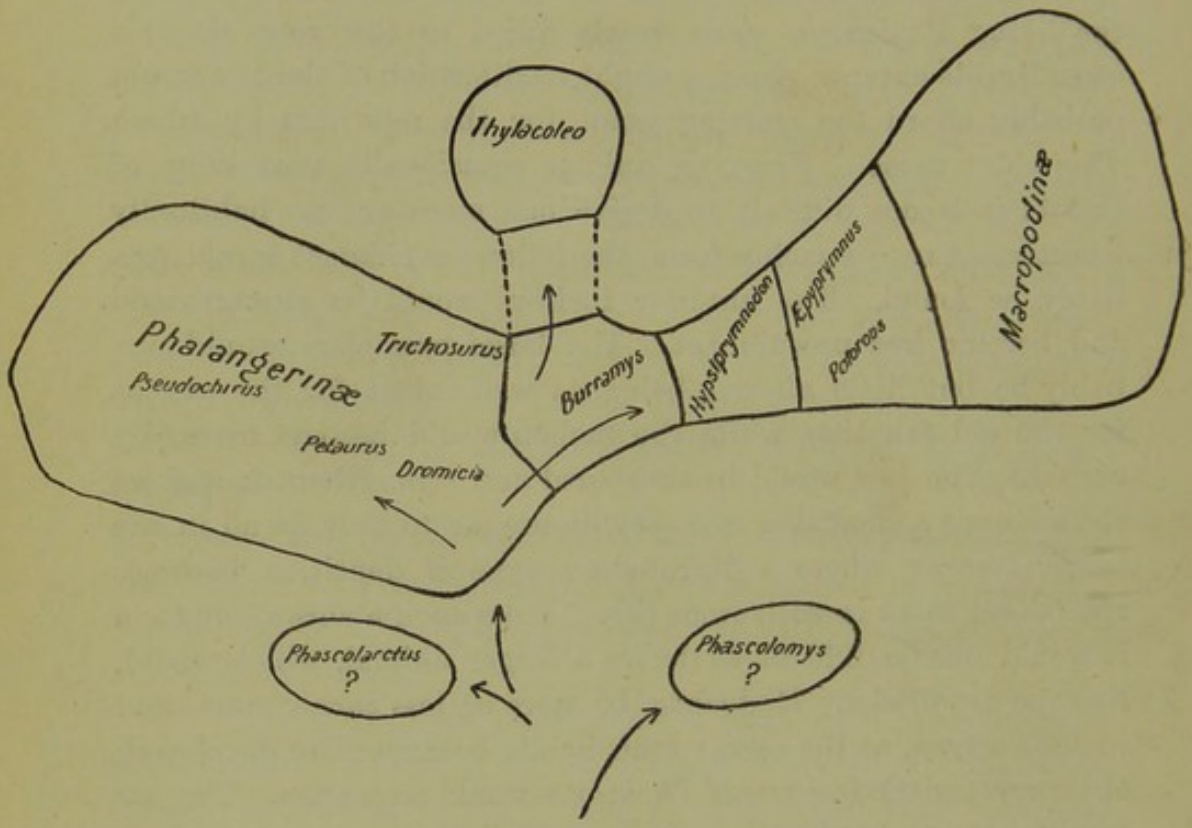
Also in *Burramys* is lost the upper p^1 which is retained in *Thylacoleo*. Still *Burramys* is probably very closely allied to the small Phalanger from which *Thylacoleo* is descended.

As already shown, small mammals which are normally herbivorous very frequently are partly insectivorous, and the type of dentition in *Burramys* is not more typically herbivorous than that in *Macroscelides*. Hence there is reason to suppose that the Burramys-like ancestor of *Thylacoleo* not improbably varied its herbivorous diet by the addition of insects; as we know the living Phalangers most nearly allied to *Burramys* do to a considerable extent. Such a slight modification of the diet would probably afford the starting point for the new line by which *Thylacoleo* arose. From an animal occasionally partaking of insects it is not difficult to derive one more or less habitually insectivorous. In such a form, the following changes would probably be found. The anterior incisors would be strengthened and become less procumbent. The large premolars would probably be but little altered, being as well suited for the new as for the old function, while the molars would become markedly cuspid. The jaw would be shortened and strengthened; and we should have a condition not very dissimilar to that found in the larger Shrews, where a diprotodont type of dentition becomes specialised to an insectivorous life. From such a shrew-like form it would not be difficult to derive a larger animal, which would, like the diprotodont Hedgehog, be more or less carnivorous; and in such a type, as the carnivorous habits became more developed, the characteristic features of *Thylacoleo* would soon arise. The jaw would become gradually more powerful, the temporal muscles greatly enlarged, and the whole face broadened and shortened to bring the piercing teeth nearer the pulling force. The great premolar would become more powerful and more specialised for cutting flesh, while the molars, being but little required, would gradually become reduced.

All that would thus be required to bridge over the gap between the more or less herbivorous *Burramyinæ* and the carnivorous

Thylacoleo would be a group of probably small insectivorous forms.

In the subjoined scheme an endeavour is made to illustrate the probable phylogenetic relationships of the Diprotodont Marsupials. The exact positions of *Phascolarctus* and *Phascolomys* are left as doubtful, and *Cœnolestes* has been omitted, as I consider the evidence which would place it with the Australian Diprotodonts not sufficiently strong, and in any case it is evidently not a near ally of any of the Australian forms.



I am much indebted to my father, Mr. John Broom, for his assistance in copying for me papers which I could not otherwise at present have had an opportunity of seeing.

Garies, Namaqualand,

February, 1898.