

## I. On some fossil remains of a Condor from Bolivia.

By

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Among the rich and valuable paleontological collections, which Baron ERLAND NORDENSKIÖLD has recently brought home from the *Tarija*-valley in southern Bolivia there are also a few bones of a bird which he has kindly handed over to me for description and determination. Before I set about this task a few notes and references may be made concerning the place where these bones have been found.

Baron NORDENSKIÖLD has recently in this journal<sup>1</sup> reported on the fossil remains of mammals found at Tarija, and at the same time described the natural conditions prevailing in this famous valley. From this short report I wish to quote some notes and refer for further information to the report itself.

The Tarija-valley is situated in southern Bolivia in the province bearing the same name. Its altitude above the sea-level is about 1,900 m. and the valley is surrounded by mountain ranges rising to a height of 3—4,000 m. The ground consists mainly of a fine dust-like material, a kind of »loess» mixed here and there with bands of sand and gravel etc. *Rio Bermejo*, here called *Rio de Tarija*, flows through the valley and the rivulets and temporary water-courses which join this river have greatly eroded the ground. In this way ravines and »barrancas» are formed which often have assumed the most peculiar and fantastical shapes (see the photos in NORDENSKIÖLD's Rep.).

The place has a long time been renowned for its fossil remains of Mammals, since these were first discovered by WEDDEL. His collections, now kept in Paris, were described by GERVAIS. Afterwards other authors have worked on material from the same place, but as far as I have been able to find out, no bird has hitherto been described from these layers.

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<sup>1</sup> Über Säugethierfossilien im Tarijathal, Südamerika von ERLAND NORDENSKIÖLD Bull. Geol. Inst. Univ. Upsala Vol. V Pt. 2 1901 N:o 10. Upsala 1902.

The most important mammals enumerated by Baron NORDENSKIÖLD are the following: *Mastodon andium*, *Equus curvidens*, *Megatherium americanum*, *Scelidotherium capellini*, *Glyptodon clavipes*, *Lestodon armatus*, *Mylo-dan robustus* and *Macrauchenia patagonica*, but also *Hydrochærus* sp., *Myo-potamus* sp., *Canis* sp. and *Machærodus*. The fossil remains were found in situ in the greyish yellow superficial layer, sometimes they lay in the bottom of the ravines and then secondarily washed down by the water from their original position.

If the mammalian remains are plentiful in the Tarija-valley this is not the case with those of birds. Those found by Baron ERLAND NORDENSKIÖLD consist of a complete tarso- metatarsus and the upper and lower ends of a femur. Both bones have belonged to the right side, no doubt, of the same bird. The bones are blackish in colour and fully petrified as may be seen at the first glance. If one should knock on them with some hard object, as for instance, a knife, a sound is produced as if they consisted of glass or some similar matter.

The bones in question have evidently belonged to a large and heavily built bird, but at the same time they have been highly pneumatic, as may be seen from the great development of the pneumatic foramina, the large pneumatic cavity and comparatively thin walls of the broken femur. The greatest transversal breadth of the proximal end of the femur, from the surface of the caput to the outer side of the ridge which extends downwards from the trochanter, is about 39 mm. while for comparisons sake may be mentioned that the same measurement of a *Cygnus olor* (in the Upsala Museum) is only 29 mm. while that of a *Vultur monachus* is 40 mm. This large size and stoutness, together with the extension of the pneumatic cavity, indicates that the femur has belonged to a large member of *Accipitriiformes*. The trochanter is strongly developed, compressed and a good deal higher than the caput so that it projects about 7 mm. beyond the same, characteristics which also indicate a bird of prey. The groove in the upper, proximal surface of the caput for the insertion of the tendon (*ligamentum teres*) is large and deep. About 16 mm. from the tip of the trochanter just inside the *crista trochanterica* there is an elongate and very deep groove or fossa — as in most *Accipitriiformes* and *Ciconiæ* — measuring about 13 mm. in length and fully 6 in breadth. In the bottom of this the pneumatic foramina are situated; the largest of which opens from a downward directed pocket into the central cavity of the bone one, or several smaller ones, open from another pocket with opposite situation, into the interior of the trochanter. On the posterior aspect of the trochanter and the expanded proximal portion of the bone several shallow, but distinct impressions for the insertion of muscles can be seen. The inner edge of the above mentioned groove in which the pneumatic foramina are situated, is somewhat raised and is continued down, the bone as a *linea aspera*. This raised line curves first towards the lateral edge of the bone, but from that it extends in a straight line downwards, being, however, a

little obliquely directed from the lateral border towards the anterior surface. About  $1\frac{1}{2}$  cm. below the caput there is on the median side a well developed tubercle and from this another raised line runs down the bone on its inner surface. The diaphysis of this femur is not quite cylindrical, the transversal diameter measuring about  $16\frac{1}{2}$  mm. and the anteroposterior one about 14 mm. at the lower end of the preserved upper portion — that is about the middle of the bone. The lower end of the femur is represented by the apophysis which has a maximum breadth of 34 mm. The popliteal fossa is deep and the condyles strongly developed, but there are no striking peculiarities about this piece of bone.

The tarso-metatarsus has a maximum length of 118 mm. It is heavily built and rather strongly flattened in an antero-posterior direction. The shaft is quadrangular in section, the anterior and posterior surfaces having the same breadth, and the lateral surfaces also being equal inter se. The proximal part of the bone shows a deep and broad groove on the anterior surface. In the deepest portion of this groove or channel there are at its proximal end two rather large foramina which perforate the bone; just below these are two distinct, raised surfaces for the insertion of *musculus tibialis anticus*. On the posterior side the hypotarsus takes the form of a strong median keel which in its proximal end is grooved on either side and expanded into a broad and, as it seems, quadrangular table; the upper right corner of which is, however, broken off in this specimen. The sides of this table project over the lateral grooves and its surface has two shallow concavities separated by a median prominence and on both sides bordered by others. At the lower end of the bone is a large foramen for the tendon of *musculus adductor digiti quarti* between the bases of the outer and middle toe. The distal trochleæ are not on the same level, but the middle one projects a good deal beyond the others, especially beyond the outer one. The middle trochlea which is much the strongest is also a good deal raised above the others in the frontal plane. The outer and inner trochleæ are produced backwards into spurlike processes, that of the outer trochlea being especially compressed and prominent.

The greatest breadth of this tarso-metatarsus is at the proximal end 27 and at the distal 30 mm. At the middle of the shaft the breadth is 13 and the thickness is about 9 mm.

If it seemed certain that the femur in question belonged to some representative of *Accipitriformes* it is still more evident that the tarso-metatarsus has done so, and at the same time several characteristic features prove that it has appertained to a member of *Cathartæ*. Such characteristics are, above all, the tabular expansion, proximally, of the hypotarsus, the fact that the trochlea for the middle toe projects beyond the others and that the tarso-metatarsus has a quadrangular section with equal lateral sides. In other *Accipitriformes* the shape of the hypotarsus is different, forming one or two crests<sup>1</sup> — except in *Serpentarius* which for other

<sup>1</sup> Or being tubular in *Pandion* and *Pernis*.

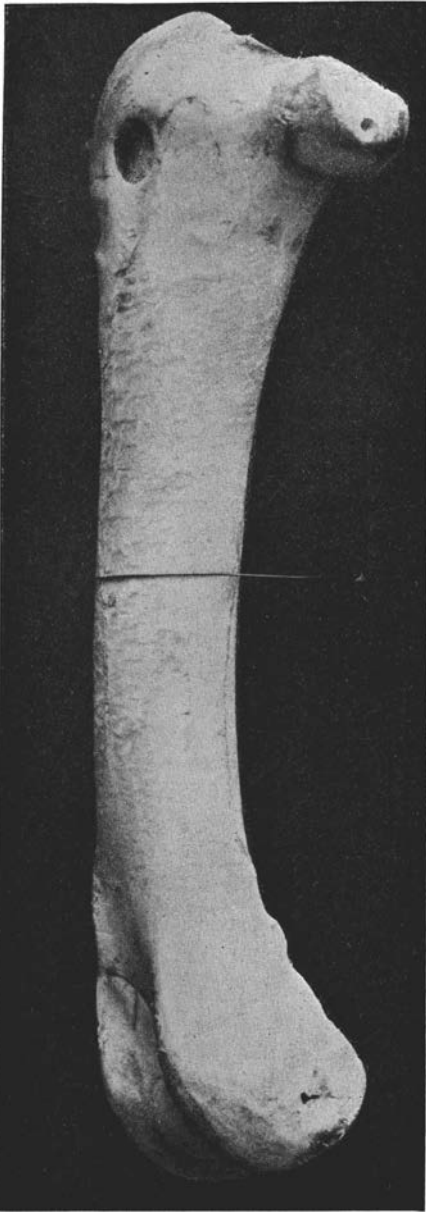


Fig. 1. Femur of the recent Condor (*Sarcorhamphus gryphus*). Anterior aspect almost nat. size (compare table of measurements). The small extension of the pneumatic fossa at the base of the trochanter and the raised line on the proximal side of the same to be compared with corresponding parts of fig. 2.

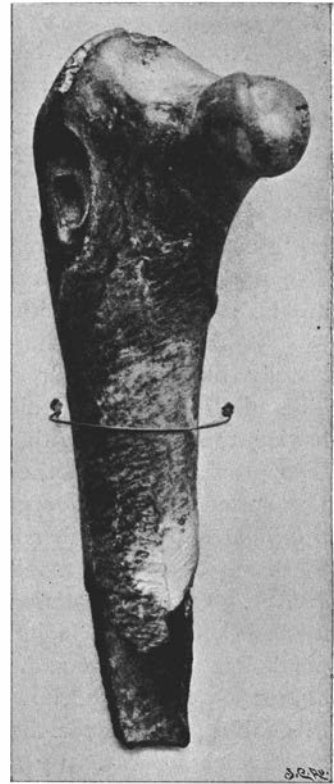


Fig. 2. Upper half of the right femur of the fossil Condor (*Sarcorhamphus patruus*) from Tarija, Bolivia. Anterior side almost nat. size (compare table of measurements). The more important differences from the corresponding bone of the recent Condor (Fig. 1) are plainly seen, viz. the great extension of the pneumatic fossa at the base of the trochanter and the structure on the median side of the same (comp. the text p. 7). Compare also the strong development of the tubercle below the caput on the median side.

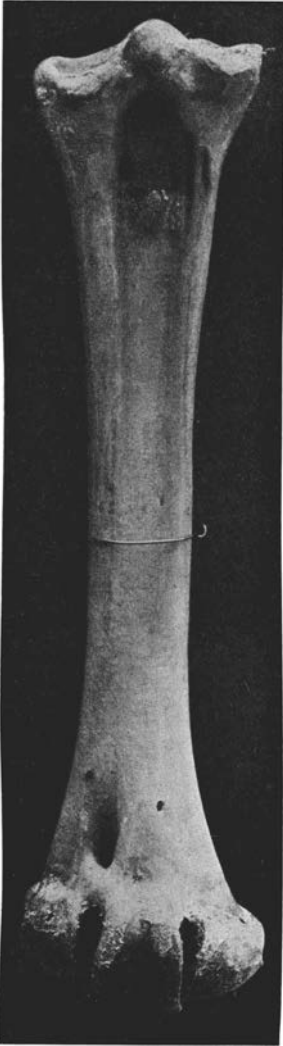


Fig. 3. Tarso-metatarsus of the recent Condor (*Sarcorhamphus gryphus*). Anterior aspect, almost nat. size (compare table of measurements). The two raised surfaces in the anterior channel for *musculus tibialis anticus* are plainly visible and so is also the ridgelike tubercle on the proximal end of the crest that borders, on the middle side, the anterior channel. The tubercle on the side of the same crest in front of the former is, however, not sharply defined owing to the darkness in the anterior end of the channel (compare the text p. 6).

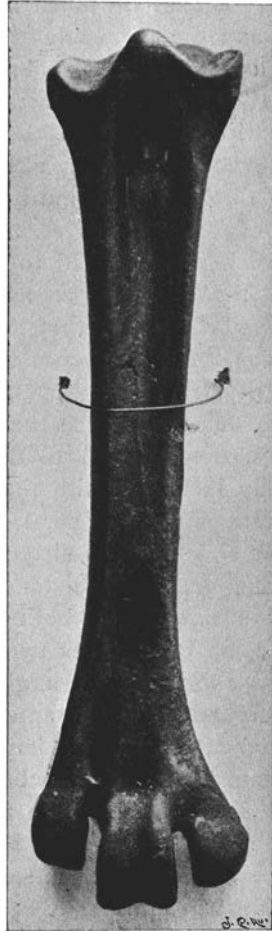


Fig. 4. Tarso-metatarsus of the fossil Condor (*Sarcorhamphus patruus*) from Tarija, Bolivia. Anterior aspect almost nat. size (compare table of measurements). Owing to the blackness of this fossil bone the details shown in fig. 3 are not so sharply defined in this reproduction. There may be seen, however, the two raised surfaces for *musculus tibialis anticus*, and the ridgelike tubercle on the median side-crest may also be traced although faintly. The general likeness to fig. 3 is apparent.

reasons cannot be taken into account here —, the distal trochleæ are on a level and the tarsometatarsus has a more or less distinctly triangular section with a sharp and thin inner border.

If from this general examination we pass to the making of a direct comparison of these fossil bones with such of recent birds, it is evident from what has already been mentioned that the corresponding bones of large *Cathartæ* first must be taken into consideration. Through the kindness of Professor F. A. SMITT, for which I beg to offer my best thanks, I have been permitted to loan from the zoological State Museum in Stockholm the right femur and tarso-metatarsus of a Condor (*Sarcorhamphus gryphus*). At the first look I was struck by the very great resemblance between the fossil bones from Tarija and those of the recent Condor. This similarity could be extended even to most details. It was thus proved to the fullest evidence that the fossil bones must have belonged to a bird quite closely related to the Condor, but, on the other hand, it could not be fully identified with the same. The likeness between both makes itself apparent in the general shape and relative dimensions as well as in the similar situation and shape of those parts of the bone to which the corresponding muscles and tendons have been attached. This likeness is especially striking when both tarsi-metatarsi are compared. There are, for instance, on both bones two raised surfaces<sup>1</sup> for the attachment of *musculus tibialis anticus*, viz. a larger, situated just behind the interspace between the two foramina in the anterior channel of the bone, and another narrower, situated at the median inner wall of the said channel. In a similar way a longitudinal ridgelike tubercle for the insertion of a muscular tendon is found in both bones (in the recent Condor on a level with the two foramina spoken of above) situated on the proximal end of the crest which on the median or inner side borders the large anterior channel of the tarso-metatarsus; and a little in front of this is another similar but somewhat shorter and broader tubercle situated on the, towards the channel directed side of the same crest and a little proximally of the former tubercle, that is higher up on the bone. There is, however, a small difference between the position of these two tubercles as may here be remarked at once. In the recent Condor both these tubercles are situated somewhat more proximally than in the fossil one. In the former the first mentioned tubercle is on a level with the two foramina in the channel and the second, the one on the side of the crest, lies well in front of the foramina. In the fossil Condor these tubercles are not situated so high up on the bone; as the first is on a level with the lower end of the foramina and the second on a level with the upper end of the same. The presence of both these tubercles is, however, an indication of a rather close relationship between the fossil and the recent Condor as no other *Cathartæ*, as far as I know, possess such tubercles, not even the King Vulture (*Gyparchus papa*). But, on the other hand, the fossil and recent Condor cannot be pleaded identical,

<sup>1</sup> I shall return to this characteristic later on.

not only on account of this small discrepancy but also in consequence of greater dissimilarities. Among the latter the difference in size must first be recorded. This is apparent from the table of measurements appended. From this may be seen that the dimensions of the femur of the fossil Condor are all of them smaller than the corresponding ones of the recent Condor except those expressing the extension of the pneumatic fossa, at the base of the trochanter. The shaft of the femur is also more compressed in an anteroposterior direction in the fossil Condor than in the recent one in which it is more equally rounded. The surfaces for the attachment of muscles at the anterior side of the proximal end of the femur near the pneumatic fossa and at the base of the trochanter are also somewhat different in the two birds as may better be seen from the accompanying figures than described. There is thus in the recent Condor a rather strongly raised line on the proximal side of the pneumatic fossa which extends upwards quite parallel to the trochanteric crest, but this is missing in the fossil Condor. With regard to the tarso-metatarsi as well, it may be seen from the table of measurements that the fossil Condor has been a good deal the smaller, and the differences in the situation of some tubercles at the proximal end of the anterior surface have already been recorded. Compared with this it is of minor importance that some *foramina nutritia* found on the tarso-metatarsus of the recent Condor partly are missing in the fossil one, partly have another position. There is also a slight difference on the proximal articular surfaces of both bones. The outer side of the distal part of the bone just above the outer toe is in the recent Condor evenly rounded in the fossil one it is more compressed and forms a blunt edge.

All this might suffice to prove that the fossil Condor is very closely related to the recent one, but, on the other hand, it is evidently so different that it must for clearness' sake be distinguished with a separate specific name of its own and I venture to propose the following: *Sarcorhamphus patruus*.

Before I had decided to do this I had, however, to extend the comparison of these fossil remains to the corresponding bones of other large *Cathartæ* among which, in the first instance, the King Vulture (*Gyparchus papa*) was to be considered. Through the kindness of Inspector H. WINGE I was permitted to borrow from the Zoological Museum of Copenhagen the right femur and tarso-metatarsus of this bird for which loan I beg to express my best thanks. A direct comparison of the bones revealed, however, at once, what already a comparison with a mounted King Vulture of the Upsala Museum had indicated and as could be concluded from descriptions, viz. that the bones of the latter are much too small to allow even a trial of identification of the fossil Condor with the King Vulture. Considering structural details it deserves also to be remarked that the pneumatic fossa of the femur of *Gyparchus* is comparatively much smaller than that of the fossil Condor (see the table of measurements).

The shaft of the femur in the former is quite round, but the shaft of the tarso-metatarsus is much more flattened than in the fossil Condor, as may be seen from the table of measurements. In *Gyparchus* there seems to be only one continuous raised surface for the attachment of *musculus tibialis anticus* in the bottom of the anterior channel of the tarso-metatarsus. The said channel looks more shallow and has more sloping sides in *Gyparchus*, but its concavity is extended comparatively further distally than in the Condors. The two small tubercles described above from the tarso-metatarsal bones of the Condors as situated on the proximal end of the crest bordering the channel on the median side are missing in *Gyparchus*. There are thus many characteristics in which the fossil and recent Condor agree inter se but both disagree with the King Vulture. There is thus no doubt that the fossil Condor from Tarija has been a *Sarcorhamphus* and not a *Gyparchus*, or at least has stood in close relationship to the former genus. The other now living members of *Cathartæ* are still smaller than *Gyparchus* and more slenderly built and are therefore easily excluded. To a certain extent the Californian *Pseudogryphus* makes an exception to this but I regret to say that no material of this one has been available to me for comparison. On a tarso-metatarsus of a *Cathartes* (*Rhinogryphus*) I have found only a single raised surface for *musculus tibialis anticus* and the tubercles of the median side-crest are wanting as in *Gyparchus*. The tarso-metatarsus of *Cathartes* is also strongly flattened as in *Gyparchus* and differs therein from the same of the Condors.

It remains now to consider, as far as is possible, the relation between the fossil Condor from the Tarija-valley and other fossil *Cathartæ*.

The late Mr. O. WINGE has described remains of a *Gyparchus* from cave-deposits in Brazil concerning which he says: »*Gyparchus affinis* papæ (vel similis) (forma quam papa multo major fort. sp. dist.)»<sup>1</sup>. Whether this one might be identical with this fossil Condor from Tarija, or not, cannot be decided upon, as unfortunately only remains of bones of the wing of the Brazilian bird are left, as Inspector H. WINGE has kindly told me. The size seems, he says, however, to correspond fairly well. But if the Brazilian bird has been a true *Gyparchus*, as I suppose it has, when that judgement has been pronounced by such an able ornithologist as Mr. WINGE, it could not, for reasons stated above, be identical with the fossil Condor from Tarija. Mr. LYDEKKER<sup>2</sup> also describes remains of an ulna from the cave-deposits of Lagoa Santa, Minas Geraes, Brazil as having belonged not only to the genus *Gypagus* (*Gyparchus*), but even to the existing species *G. papa*. In such a case I think that although the material from the Brazilian caves is rather scanty one may have a right to regard, on such authorities, the Brazilian cave-vulture as a real *Gyparchus*.

Remains ascribed to several fossil members of *Cathartæ* have also

<sup>1</sup> E Museo Lundii Bd. 1.

<sup>2</sup> Cat. Foss. Birds, Brit. Mus. London 1891, p. 34.



been described by MORENO and MERCERAT<sup>1</sup>. The material on which these descriptions are based is however exceedingly scanty. In two instances a comparison with the remains of the Condor from Tarija can be made, namely with the *Psilopterus communis* and *Ps. australis* of which pieces of the tarso-metatarsal bones have been recovered. The genus *Psilopterus* established on these remains is said to form a transition between *Cathartes* and *Sarcorhamphus*. *Psilopterus communis* seems to have been a good deal smaller than the fossil Condor from Tarija and there is at the distal end of the tarso-metatarsus of the former a groove separating the outer metatarsal from the middle one. In the corresponding place in the fossil Condor from Tarija there is not the slightest trace of such a groove. *Psilopterus australis* agrees better with this latter with regard to its size, but the generic difference from *Sarcorhamphus* remains. There are also some discrepancies with regard to the relative dimensions. Thus, for instance, the distance between the foramen for the tendon of *musculus adductor digiti quarti* and the distal end of the middle trochlea is considerably larger in the fossil Condor from Tarija than in *Psilopterus australis*. In the former the tarso-metatarsus is much more suddenly narrowed from the expanded distal end in a proximal direction towards the shaft than in the latter so that the shape or outline of the distal half of both bones thus becomes different. In the former the narrowest part of the shaft (12 1/2 mm.) lies about 42 mm. from the distal end. In the latter the breadth at such a distance from the distal end is decidedly greater than at a distance of 55 mm. (and the fragment is not longer).

Finally MORENO and MERCERAT (l. c.) have described the ulna of a Vulture named by them *Sarcorhamphus fossilis*. Whether this bird might be identical with the Condor from Tarija, or not, cannot be discerned at present as corresponding bones have not been found. The authors quoted say that they regard *S. fossilis* to have had approximately the size of *S. gryphus*. If the size of the former has been quite as large as that of the latter, *S. fossilis* has been larger than the bird for which I have proposed the name *S. patruus*.

It seems accordingly to exist a strong probability that these remains collected by Baron ERLAND NORDENSKIÖLD represent an extinct and hitherto unknown member of *Cathartæ* most closely related to the recent Condor.

Before I conclude this report I wish to draw the attention to a very interesting fact, namely that the tarso-metatarsus of the Condor, the recent as well as the extinct one described above, has, in the proximal end of its anterior groove or channel, two raised surfaces for the attachment of *musculus tibialis anticus*. In this respect the Condors agree with *Serpentarius*. PYCRAFT states in a paper published quite recently that *Serpentarius* alone has two such raised surfaces, but *Cathartæ* only one. He has

<sup>1</sup> Anales del Museo de la Plata. I 1891 p. 67—69.

<sup>2</sup> Proc. Zool. Soc. 1902.

then evidently overlooked the condition prevailing in the Condor. But the resemblance between the Condor and *Serpentarius* with regard to the structure of the tarso-metatarsus is still more striking. There are namely to be found in the latter as well as in the Condor the elongate ridge-like tubercle described above as situated in the Condor on the proximal end of the crest bordering on the median or inner side the anterior channel of the tarso-metatarsus; and the other tubercle situated in the Condor on the towards the channel directed side of the same crest may in *Serpentarius* also be traced as an elongate ridgelike prominence with a corresponding position. PYCRAFT has (l. c.) pointed out other resemblances in osteological structures between the *Cathartæ* and *Serpentarius* as for instance the shape of the hypotarsus which differs from that of other *Accipitriformes*, further the mutual situation of the distal trochlea and the deeply grooved anterior surface of the tarso-metatarsus. It is, however, evident that in the above recorded details *Sarcorhamphus* resembles *Serpentarius* more than other *Cathartæ* do and that consequently the two genera mentioned in this respect have retained ancient characteristics inherited from the common ancestors. It is namely more than probable it seems certain, that this likeness in structure is due to inheritance and not to a convergence in the development, especially when one considers the great specialisation and adaption to a certain mode of life which the legs of *Serpentarius* have been subjected to. But then at the same time a hint is given that *Sarcorhamphus*, at least in some respects, is more primitive than other *Cathartæ*.

The unmistakable genetic affinity between Secretary-birds and Condors does not, however, in itself prove any direct connection or communication between the African and South American fauna, because MILNE EDWARDS has from the Lower Miocene of Europe described a less specialised Secretary-bird (*Serpentarius robustus*) distinguished by its shorter and stouter tarso-metatarsus. From North-America fossil *Cathartæ* are known.

The age of the fossil Condor from the Tarija-valley is most probably the same as that of *Mastodon andium* and other mammalian remains. It is thus comparatively young from a geological point of view as it must have become imbedded in those layers since a terrestrial connection between the North and South-American continents had been effected and the great invasion of northern Mammals into South America had taken place. The hypothesis could therefore be put up that the South-American *Cathartæ* had followed the invasion of large Mammals into South America. It is true that other large Mammals existed in South America before that invasion, but there were no carnivorous animals present, as all those, *Machærodus* a. o. are of northern origin. But the presence of carnivorous animals and of large mammals on which the former can prey, means that carrion may be plentiful. Such an hypothesis should therefore have been quite plausible, when ancestral *Cathartæ* are known as well from Europe as from North America and when these scavengers largely feed

on carrion, if *Psilopterus* had not been found in the Santa Cruz deposits, which are earlier than the land-connection between the two American continents. If those birds, the remains of which have been named *Psilopterus*, be true *Cathartæ*<sup>1</sup> it is thus proved that this group of birds inhabited South America before the landbridge in the north was formed. If not, and if future discoveries should exclude *Psilopterus* from the true *Cathartæ*, then I think my theory about the origin of the South American *Cathartæ* may hold good. *Sarcorhamphus fossilis* and *Cathartes fossilis* are »post-pampeen», thus very late and of no influence on the above statement.

### Measurements:

<i>Femur:</i>	Recent Condor. Fossil Condor. King Vulture.		
Greatest transverse measurement from the caput to the outside of the trochanteric crest . . . . .	43 mm.	39 mm.	29 mm.
Antero-posterior diameter of the caput	19 »	16 »	13 »
Length of the groove for the pneumatic foramina below the trochanter . . . . .	9 »	13 <sup>1</sup> / <sub>2</sub> »	7 <sup>1</sup> / <sub>2</sub> »
Breadth of the same . . . . .	6 »	6 »	5 »
Greatest breadth in antero-posterior direction of the proximal surface between the caput and the trochanter . . . . .	20 »	18 »	15 »
Transverse diameter of the middle of the shaft . . . . .	19 <sup>1</sup> / <sub>2</sub> »	17 »	13 <sup>1</sup> / <sub>2</sub> »
Antero-posterior d:o . . . . .	18 »	14 »	13 <sup>1</sup> / <sub>2</sub> »
Transverse breadth at the middle of the lower articular surface .	37 »	34 »	25 »
<i>Tarso-metatarsus:</i>			
Greatest total length . . . . .	135 »	118 »	106 »
Greatest transverse breadth of the upper end . . . . .	30 »	27 »	21 »
The same of the lower end . . . . . (anteriorly)	33 <sup>1</sup> / <sub>2</sub> »	30 »	—
Transverse diameter of the middle of the shaft . . . . .	14 »	13 »	11 »
Anteroposterior d:o . . . . .	10 »	9 <sup>1</sup> / <sub>2</sub> »	6 »

<sup>1</sup> The possibility does not seem to be excluded that *Psilopterus* has belonged to some other group as the genus is rather insufficiently known. The presence of a groove separating the outer metatarsal from the middle one in *Psilopterus communis* indicates that this bird has been less specialised than the *Cathartæ*. Perhaps *Psilopterus* includes ancestral types related to *Chauna* although with more powerful claws. At present the question about their affinity can hardly be settled.