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Colour dark olive throughout, with the exception of a white band, which crosses the anterior border of the snout, and passes backward to the posterior third of the lateral fissure, where it bends dorsally and terminates.

The special characters are the very large mouth, with the prominent rugæ, which show that the animal probably possesses unusual powers of œsophageal protrusion—a supposition borne out by the great development of the external circular muscular fibres and the succeeding longitudinal coat of the organ. The internal glandular lining is also very firm. The outer layers of the proboscis correspond with the type in the *Lineidæ*; but the internal longitudinal layer is largely developed.

Hab. Swain's Bay, Kerguelen's Island (*Eaton*).

XXXII.—*Extinct* LEMURINA.

By WILLIAM HENRY FLOWER, F.R.S.

THE animals commonly known as Lemurs, from the island of Madagascar, and certain nearly related species from the African continent and the southern parts of Asia, constitute a well-defined group of mammals, which were formerly associated with the Monkeys in the Linnean order *Primates*, and the Cuvierian *Quadrumana*, forming in the latter the third main division *Strepsirrhina* (Geoff. St.-Hilaire). As more complete knowledge of their organization has been gradually attained, the interval which separates them structurally from the Monkeys has become continually more evident; and since they cannot be placed within the limits of any of the previously constituted orders, it has been considered advisable by some naturalists to increase the ordinal divisions in their behalf, and to allow them to take rank as a distinct group, related to the *Primates* on the one hand, and to the *Carnivora* and *Insectivora* on the other*.

The disputed zoological position of the Lemurs, and the great importance which has been attached to them by some zoologists, such as Hæckel, who regard them as the direct transition between the lower and higher mammals, and as survivors of a

* For the arguments in favour of this view see Alphonse Milne-Edwards, "Observations sur quelques points de l'embryologie des Lémuriens et sur les affinités zoologiques de ces animaux," *Ann. des Sciences Nat.* Oct. 1871; and P. Gervais, "Encéphale des Lémures," *Journ. de Zoologie*, t. i. p. 7. For those for retaining them among the *Primates*, see Mivart "On *Lepilemur* and *Chirogaleus*, and on the Zoological Rank of the Lemuroidea," *Proc. Zool. Soc.* 1873, p. 484.

large group, now almost extinct, through which the higher Primates, including man, must have passed in the progress of their development, make the consideration of their ancient history one of great interest.

Until very recently fossil Lemurs were quite unknown; at all events the affinities of certain remains provisionally assigned to the group were much questioned; but within the last few years the existence of Lemuroid animals in Europe during the later Eocene and early Miocene periods has been perfectly established, and remains of a large number of animals attributed, though with less certainty, to the group have been found in beds of corresponding age in North America.

In 1862 Rütimeyer described the fragment of a right maxilla and three molars from a siderolitic deposit (Bohnerz) at Egerkingen, near Soleure, Switzerland, under the name of *Cænopithecus lemuroides*, supposing them to belong to an animal partaking the characters of the American Monkeys and the Lemurs. These remains have, however, by most other palæontologists, been referred to an Ungulate.

More recently M. Bétille discovered, in deposits which are being worked for phosphate of lime at Sainte Néboule de Bédrier, Department of Lot, France, attributed to early Miocene age, the nearly complete cranium, and subsequently, at the same place, a portion of a ramus of a mandible of apparently the same species of animal. These were described by M. Delfortrie, in the 'Actes de la Société Linnéenne de Bordeaux,' t. xxix. 1^{re} liv. 1872*, under the name of "*Palæolemur Bétillei*;" and through the kindness of M. Delfortrie and Professor Gervais, of Paris, excellent casts of both are in the Museum of the Royal College of Surgeons. The cranium is generally well preserved; but unfortunately the anterior part, containing the incisor and canine teeth, has been broken off. The crowns of the premolars also are destroyed; but their number and characters are indicated by their roots, and the molars are complete on both sides. The affinity to the Lemurine animals, and especially to the African forms, the *Nycticebinæ* and *Galaginæ*, is chiefly shown by the general form of the cranium, the large size and anterior direction of the orbits, the small and narrow muzzle, and the position of the lachrymal foramen outside the anterior edge of the orbit. In size the fossil is intermediate between the Potto (*Perodicticus potto*) and *Galago crassicaudatus*. The whole skull, however, is more depressed, the orbits are smaller, the brain-cavity relatively smaller and more constricted behind the orbits, and the

* See also 'Journal de Zoologie, tome ii. p. 415.

muscular ridges more developed than in any existing member of the group. The occipital ridge is very marked; and the upper borders of the temporal muscles meet in the middle line, forming a well-marked sagittal crest, as is the case with *Loris tardigradus* and the larger Galagos, but not with the Potto.

The ramus of the mandible is considerably deeper and stouter than in any existing form. The number of the molar series appears to be $p. \frac{4}{4}$, $m. \frac{3}{3}$, the typical number in the Eocene mammals, and therefore one more premolar than in the existing *Lemurinae*, and two more than in the *Indrisinae*. The upper molar teeth are of a much more simple and primitive character than in existing Lemurs, being nearly equal in size and having nearly square crowns, with four distinct cusps, one at each angle, rather obliquely placed, the inner ones behind the corresponding outer cusps, and with the transverse or rather oblique connecting ridges but little developed. The third molar has the postero-internal cusp rudimentary.

In the mandible six teeth are preserved, the two in front (pm. 2 and pm. 3) each with one cusp. In the third (pm. 4) the cusp is broad and almost bifid, and the heel is so well developed that it closely approaches a true molar in form. The latter show very much the characters of the lower molars of the smaller Lophiodons, having two pairs of obliquely placed cusps, connected by transverse ridges, anterior and posterior, with an oblique ridge running forwards and inwards from the postero-external cusp. The last has an additional posterior tubercle. This pattern of tooth, which is the foundation of that of all the Perissodactyles, however modified, is also that on which that of the existing Lemurs is based, and is retained most clearly in the Tailless Potto (*Perodicticus calabarensis**).

On the whole, then, it appears that the animal whose skull was discovered at Bédouer was correctly assigned by Delfortrie to the Lemurine group, though it cannot be placed in any of the existing genera, and shows in all its cranial and dental characters such modifications as might be expected in an ancient form, being decidedly more generalized and lower than any of the living Lemurs. Of these, however, it more nearly resembles the Indo-African forms, and not those of the island of Madagascar or of the extreme east, having no near relationship with *Tarsius*, *Chiromys*, or the *Indrisinae*, and not much with the true Lemurs. If the bones of its feet could be found, their structure would afford most valuable evidence of the

* See Huxley, "On the Angwantibo (*Arctocebus calabarensis*)," Proc. Zool. Soc., June 28, 1864.

state of development of the group at the period in which it lived.

A most interesting circumstance was brought to light when M. Delfortrie's specimen came into the hands of M. Gaudry, of Paris. That experienced and accurate palæontologist, with the rich treasures of the Paris Museum at his hand for comparison, recognized that certain more or less fragmentary specimens which had long been in the collection, and had been described from the teeth alone, and generally, though doubtfully, referred to the Ungulata, were really nothing more than animals of the same group, and probably even the same species as *Palæolemur Betillei*. These are:—*Adapis parisiensis*, Cuvier, from the Paris gypsum, described and figured in the 'Ossements Fossiles'; *Aphelotherium Duvernoyi*, Gervais, from the same beds; and other specimens from Barthélemy, near Apt. This result is fully acquiesced in by Gervais*, who also adds *Cænopithecus lemuroides*, Rütimeyer, to the synonyms of the animal, which must henceforth be called *Adapis parisiensis*, as that was the first name assigned to it.

M. Delfortrie's announcement of a fossil lemur from the south of France was soon followed by that of another species by M. H. Filhol, named *Necrolemur antiquus* ('Comptes Rendus,' 1873, tome lxxvii. p. 1111), which was afterwards more fully described and figured in an important memoir†, in which the Lemurian affinities of *Adapis* are criticised, and a second and considerably larger species, *Adapis magnus*, Filhol, found in phosphatic deposits at Raynal, added to the group. The latter, of which the skull was upwards of four inches in length, resembles M. Delfortrie's in its general characters, but modified much in the way that the skulls of larger animals of natural groups differ from the smaller ones. The brain-chamber and orbits are relatively smaller, the face larger, the muscular crests more developed, the constriction between the cerebral and facial portions of the skull more marked. These modifications remove the skull in its general characters still further from the existing Lemurs—so much so that M. Filhol refers it and the other species of *Adapis* to a distinct and hitherto unknown zoological type, intermediate between the Lemurs and the Pachyderms, to which he gives the name of *Pachylemur*. On the other hand, the *Necrolemur antiquus* found at St. Antonin, which is a very small species, scarcely exceeding the smallest living Lemur (*Chirogaleus rufus*) in size,

* Journal de Zoologie, tome ii. p. 421.

† "Nouvelles Observations sur les Mammifères des Gisements de Phosphate de Chaux (Lémuriens et Pachylémuriens)," Annales des Sciences Géologiques, tome v. (no. 4), 1874.

he considers to be a true Lemuroid, more nearly resembling *Galago senegalensis* than any other existing species. Unfortunately, as in both the other examples, the anterior part of the face is so much injured, that the characters and number of the incisor teeth cannot be ascertained. This is a great want in determining the true affinities of these animals, as the condition of the incisors is very characteristic of all modern Lemurs. M. Filhol assumes that there are but three premolars above and below in *Necrolemur*, and that it presents therefore a much closer resemblance to the true Lemurs than to his Pachylemurs; but I do not see (judging only by the figures which he gives) why the first tooth present should not be a premolar as well as a canine, in which case the dental formula would be the same in both; and otherwise it appears to me that the three heads he figures (*Necrolemur antiquus*, *Palæolemur Betillei*, and *Adapis magnus*) form a natural series, the first standing to the second very much in the same relation of proportions &c. as this does to the third. This is particularly well seen in the upper surface, where the temporal crests are separate as far back as the occiput in the little *Necrolemur*, unite about the middle of the parietal region in *Palæolemur*, and in the frontal region in *Adapis magnus*. Similar differences are found among existing members of closely allied forms, in the Carnivora, Insectivora, and even the Lemurs themselves. I therefore do not think that M. Filhol's conclusion that *Necrolemur* is to be regarded as an early Miocene Lemurine, only generically separated from *Galago* or *Hapalemur*, while *Adapis* is a representative of a totally distinct zoological type, is admissible. Such evidence as is before us leads to the supposition that all three are nearly related primitive Lemuroids; but, in the absence of all knowledge of the structure of the limbs, their position cannot be satisfactorily determined.

The recognition of some of the supposed Ungulates of the Paris gypsums as Lemuroids shows how little reliance can be placed upon the characters of the molar teeth alone in judging of the affinities of an animal, and must also lead to the re-examination of some of the smaller mammals of our own Tertiaries, such as *Miolophus*, as it is not improbable that Lemurs may be found among them.

Perhaps the most important of all the numerous recent palæontological discoveries in the Tertiary beds of the Rocky-Mountain district of North America has been that of animals which their describers believe to be low and generalized forms of the order Primates. Their existence was not suspected till

1872, in which year Professor Marsh* and Professor Cope† almost simultaneously announced the fact. Since that time as many as fifteen genera have been assigned to the group, including five previously described by Leidy from teeth alone as being of uncertain position. These are nearly all from Eocene formations, though two have been found in the lower Miocene.

Until we receive fuller information and figures or casts of the remains of these animals, it is premature to speculate upon their real characters or affinities. The difficulty of doing so at present is enhanced by their describers, in the provisional accounts already given, adopting the old assumption that Lemurs and Monkeys are very nearly related, and speaking of them sometimes as one and sometimes as the other. Of course it is possible that these animals or some of them may have been Monkeys, in which case they were not Lemurs; or they may have been Lemurs, in which case they were not Monkeys‡. It is possible also that they may form the connecting link between the two, and so justify their old association in one group. Looking at their geographical position, we should be more inclined to regard them rather as the ancestral forms of the present American monkeys, or perhaps of all the *Simiina*, since there seems great reason now to believe that North America was in those days a great region of development, in which arose many of the forms which spread at a later period over the Old World. In this case the Lemurs, which, judging from their present distribution, appear to have spread east and west from Madagascar, or the hypothetical submerged continent "Lemuria," may have had quite a different origin.

The question can only be determined by a rigid and unbiased comparison of the remains, when sufficient materials have accumulated, and is without doubt one well worthy of the devotion of any amount of patience and labour which may be bestowed upon it.

* Am. Journ. Sci. & Arts, vol. v. p. 405, Nov. 1872.

† Proc. Amer. Philos. Soc. 1872, p. 554. See also Cope, "On the Primitive types of the orders of the Mammalia *Educabilia*," Am. Philos. Soc. April 18, 1873; and Marsh, Am. Journ. Sci. & Arts, vol. ix., March 1875.

‡ Prof. Marsh expressly states, "From numerous specimens the writer has ascertained that the *Limnotheridæ* should be placed in the *Prosimiæ*. The brain was nearly smooth, and the cerebellum large and placed mainly behind the cerebrum. The orbits are open behind, and the lachrymal foramen is outside the orbit." The last-mentioned character is certainly specially Lemurine, though the others are common to the early types of mammals, and widely different from those of modern monkeys.