

**On the Structure of the Hairs of Mylodon
Listai and other South American Edentata.**

By

W. G. Ridewood, D.Sc., F.L.S.,

Lecturer on Biology at the Medical School of St. Mary's Hospital, London.

With Plate 26.

THE interest attaching to the discov-
preserved skin of a great Ground Sloth, very closely allied to
if not identical with Mylodon, was considerably increased
when it was found that the hairs do not agree in their minute
structure with those of the Tree Sloths, Bradypus and
Cholœpus. While agreeing with the latter in the absence
of a definite medulla, they are destitute of the extra-cortical
layer which characterises the hairs of Bradypus, and have
not the fluted surface which is such a distinctive feature of
the hairs of Cholœpus. The characters of the hairs have
been commented upon by several authors in the course of
their remarks upon the remains of this ground sloth, but the
subject has never been treated exhaustively; and Professor
Ray Lankester suggested to me that the matter was worthy
of further inquiry, and that it was desirable to compare the
newly discovered hairs not only with those of Bradypus
and Cholœpus, but also with those of the ant-eaters and
armadillos.

The order Edentata, as at present constituted, will proba-
bly prove to be an unnatural assemblage of animals, and it
may become necessary, when our knowledge is more complete,

to remove the Old World forms *Manis* and *Orycteropus*, to constitute two new orders by themselves. For the present purpose, however, the relationships are not material, except for the fact that the late traveller Ramon Lista saw and shot at a curious animal in South America, which he likened to a hairy and scaleless Pangolin. It is generally denied (Ameghino [1], Lönnberg [7, p. 168]) that this "pangolin" was the *Mylodon* of which the skin and bones have more recently been found.

Accounts of the various pieces of skin discovered have been published by Ameghino (1), Lönnberg (7), Roth (14), Smith Woodward and Moreno (18), and Smith Woodward (19). The locality from which Dr. Ameghino obtained his specimen is not stated, but the other pieces of skin were found on different occasions in the loose earth of a cavern near Consuelo Cove, Last Hope Inlet, Patagonia. The deposit in which they were found is regarded as of Pampean age, and there can be no doubt that these ground sloths were contemporaneous with man, if not actually living in the cavern in a state of domestication.

Concerning the generic name, there appears to be no valid reason why *Mylodon* should not be used. The genus was first established by Owen in 1840 (11, p. 68), the type species being *Mylodon Darwinii*. Two years later Owen (12) described a nearly complete skeleton of a ground sloth which he called *robustus*, and referred to the same genus. Reinhardt (13), writing in 1879, showed that the two species were generically distinct, and renamed the earlier specimen *Grypotherium*. If, however, the rules of priority are to be observed at all, the term *Mylodon* should be retained for the species *Darwinii*, and the *robustus* should be accorded a new generic name. The argument that the species *robustus* was fully described, whereas *Darwinii* was represented only by a fragment of jaw, is obviously inadmissible, for if the fragment is sufficiently perfect to enable Reinhardt's specimen and those recently discovered to be regarded as generically identical with it, it is sufficiently perfect and important to

act as the type of the genus. *Glossotherium*, a genus founded by Owen in 1840 (11, p. 57), is admitted by himself (12, p. 154) to be identical with *Mylodon Darwinii*, and this genus may thus be dismissed as a synonym of *Mylodon*. The same fate befalls *Neomylodon*, since the newly discovered specimens to which the name was applied are widely regarded as generically, if not specifically (Nordenskjöld [10]), identical with Owen's *Mylodon Darwinii*. Until, however, the specific identity has been more fully established it is preferable to retain Ameghino's specific name of *Listai* for these remains.

The hairs of *Mylodon Listai* have been described by Lönnberg (7), Jacob (4), and Smith Woodward (18 and 19), and transverse sections have been figured by the first two authors. The descriptions presuppose a knowledge of the hair structure in *Bradypus*, the ant-eaters and armadillos, and so in the present communication the consideration of the *Mylodon* hairs and the criticism of the views of these three authors are left till the last.

The method adopted for the examination of the hairs was in all cases the same. The hairs were arranged with the roots pointing one way and the free ends the other; they were tied up in bundles, stained with a weak alcoholic solution of magenta, washed and dehydrated. The bundles were then soaked in xylol, and transferred to hard paraffin. After cooling the paraffin was cut into convenient blocks, and the sections were made by hand with a sliding motion of the razor. It was found that better results were obtained in this way than by the employment of any form of microtome. Some of the sections were mounted in glycerine jelly, but the majority in Canada balsam, since the former medium has the disadvantage of dissolving out the stain. A few hairs of each of the species studied were stained and mounted whole. For the *Mylodon* hairs I am indebted to the kindness of Dr. F. P. Moreno; the hairs of the other *Edentata* were obtained from dried specimens in the Natural History Museum, London.

Bradypus tridactylus.

The hairs of *Bradypus* are oval in section, and exhibit a central clear area and a darker marginal area (fig. 3). The central area stains very faintly if at all with magenta, and being brittle is apt to crack in the cutting. It is marked by a small number of minute air spaces, the true shape of which is fusiform. The long axis of each spindle is parallel to the length of the hair, and consequently the transverse sections of the spaces are larger or smaller according as they are cut through the middle or near the ends of the spindles. The outer substance stains deeply, and is thickly marked with dark granules, and exhibits at the same time two sets of radiating lines—a set of very fine and closely set lines around the outer edge, and a set of coarser and more irregular lines branching out from the central mass. The average size of the transverse section is $240\ \mu \times 145\ \mu$.

The outer substance is a layer not represented, or at least not in this form, in the hair of any other mammal. It does not extend the full length of the hair, but stops short near the free end, and is absent from the basal third of the hair. In optical section (fig. 4, upper part) it exhibits an oblique striation. The terminal portion of the hair (the "Endfaden" of Welcker [17]) has the normal structure of a non-medullate hair with a scaly cuticle, but at a certain distance from the point the diameter increases quite suddenly by the addition of this new layer (fig. 2). The diminution in the width of the central core at this point is probably not real, but an optical effect due to the refrangibility of the external layer. The figure represents an optical section, not an actual slice taken from the middle of the hair. The basal third of the hair is thin as compared with the distal part, and measures only $64\ \mu$ across (fig. 6); it appears transparent when the hair has been clarified and mounted whole. In addition to the minute fusiform air spaces it frequently has larger air-filled cavities, blunt ended, and about $60\ \mu$ long and $6\ \mu$ broad. The transverse section of this part of the hair is nearly

circular (fig. 5). In all parts of the hair of *Bradypus* the cuticular scaling can be seen by suitable staining and accurate focussing.

That the central part of the hair of *Bradypus* is a cortex, and not medulla, as Eble supposed (2, Bd. ii, p. 440, and Taf. x, fig. 111), and that the peripheral part is extra-cortical, has been ably shown by Welcker (17), who applied the name "Belegschicht" to it. The relation which the extra-cortical layer bears to the normal cuticle is very difficult to determine. A careful examination of the part of the hair where the transition occurs between the normal terminal portion and the part provided with the extra-cortex (fig. 2) shows that the arrangement of the imbricate scales of the cuticle is continued without interruption upon the exterior of the extra-cortical layer, thus seeming to show that the cuticle is continued over the outer surface of this layer. The extra-cortex, however, is very friable in old hairs, and comes away readily, leaving the central column of cortical substance bare; and it is then seen that the surface of the column is marked by lines taking a more or less transverse course, and suggesting forcibly that the cuticular scaling is continued on the surface of the cortex beneath the extra-cortical layer. There is yet a third possibility, which may eventually prove to be the correct interpretation, since it accounts for both sets of appearances. It is that the extra-cortical layer is the cuticle itself, enormously thickened and distinctly cellular, instead of more or less homogeneous and structureless. The arrangement of the cells would account for the markings on the external surface of the hair, and the scaly appearance of the cortical rod when laid bare would be due to the impress left by the extra-cortical cells. The appearances presented by that basal part of the hair where the extra-cortex is just dwindling away certainly favours the third supposition. The cells of the extra-cortex get thinner and thinner, and come to resemble the scales of the cuticle. They become more firmly adherent to one another and to the cortex, they appear more homogeneous, and they stain less deeply. The figure given

by Welcker (17, Taf. ii, fig. 11) of the young hair in its follicle at a time when the extra-cortex is forming would appear to allow of no alternative proposition. Yet Welcker was disposed to regard the Belegschicht as a new tissue intercalated between the cuticle and the cortical rod (17, p. 44); and the effect obtained by macerating the hair in water, and thus causing a thin cuticular layer to peel off (17, Taf. ii, fig. 14), lends support to his view. But this effect is very possibly due to the excessive cuticularisation of the outer parts of the external cells, and not to any morphological distinction of layers.

Leydig (6, p. 687) took the extra-cortex, or at least a part of it, to be the cuticle, for he observed that, contrary to the generalisation made by Reissner and Reichert, the hair cuticle does contain pigment granules in one mammal, namely, *Bradypus*. Waldeyer (16, p. 186) supported, in the main, Welcker's contention, and regarded the "Rindenmantel" as a layer peculiar to the sloths, and lying below the cuticula; and Leche (5, p. 934) is probably only adopting Welcker's suggestion when he remarks of the "Umkleidungs-schicht" that "sie besteht aus einer zwischen Cuticula und Rindensubstanz gelegenen pulpösen, lufthaltigen Zellenschicht." Maurer (8, p. 278), on the other hand, holds that the thickening of the distal part of the hair of *Bradypus* is mainly effected by the cuticle (Oberhautchen). His account, however, is very confusing, since he speaks of a medulla extending two thirds of the length of the hair, and of the cortical cells being pigmented; and although he gives the title of Welcker's classical paper in his bibliography, he fails to contrast his own observations with those which this author had already placed on record.

The biological significance of the extra-cortical layer is full of interest, and has been made known by the writings of Welcker (17) and Sorby (15). The layer has a tendency to crack in a transverse direction, and in the cracks there come to lodge unicellular algæ, to which Kühn (17, p. 66) has given the name *Pleurococcus Bradypii*. The moisture of

the climate in which *Bradypus* lives enables the alga to live and propagate in this curious position, and the sloth acquires a general green tint, which must render it very difficult to distinguish as it hangs among the green foliage. In thick transverse sections of the hair these algal bodies show up very clearly, since they stain deeply, and have a sharply defined, circular or slightly oval outline. Unless the hair is much broken they are confined to the outer parts of the extra-cortical layer.

In addition to the larger hairs just described, *Bradypus* has a set of shorter and much finer hairs, constituting the under-fur. These hairs have a diameter of $24\ \mu$, and consist of a column of cortical substance traversed by fine fusiform air spaces, and covered by an imbricated cuticle (fig. 7). Like the larger hairs of the body, they have no medulla.

Cholœpus didactylus.

The hairs of *Cholœpus* are no less remarkable than those of *Bradypus*, but in a totally different way. The bulk of the hair is composed of cortex, the surface of which is fluted or channelled. The grooves, as is well known, are occupied by strands of extra-cortex, in which lives an alga—the *Pleurococcus Cholœpi* of Kühn (17, p. 66). Even from the hairs of dried museum specimens a green solution, giving the absorption bands of chlorophyll, can be obtained by boiling first in water and then in alcohol.

When seen in transverse section (fig. 8) the outline is oval, and measures about $150\ \mu \times 90\ \mu$. The cortical substance is in some cases quite clear and hyaline, but in others it is marked by brown spots—differences presumably related to the age of the hairs. In both cases this cortical substance does not stain with magenta. But running throughout, except towards the summits of the superficial ridges of the hair, are irregular branching lines, which stain deeply, and are discernible in unstained sections by reason of their different refrangibility. In very thin sections these lines are

seen to be empty tubes, with a deeply staining lining. These conditions do not appear to be paralleled in the hair of any other animal. The branching tubes may possibly represent a diffused medulla, for in most hairs the medulla stains deeply and becomes largely infiltrated with air. This is the view taken by Waldeyer (16, p. 187), who writes that the hair shows "einen grossen centralen Markstrang, der aber durch Balken von Rindenschicht vielfach durchsetzt ist," and by Welcker (17, p. 55), according to whom "diese Markröhre ist, wie bereits Erdl [3] erwähnt, innerhalb des dickeren Thiels des Haars nicht circumscripirt, sondern in eigenthümlicher Weise mit Rindenschicht untermischt." Maurer's account of the hair structure in *Cholæpus* (8, p. 278) is as unintelligible as his description of that of *Bradypus*. He speaks of the cortex being thin in the broad part of the hair, thereby implying that a compact central medulla is present.

The cuticle is present, and it is imbricate, as can be seen by the serrated appearance of the edge of the hair when viewed in optical section. By staining rapidly, and washing before the deeper parts of the hair have become affected, the edges of the scales can be seen when the surface of the hair is in focus. This is particularly the case with the hairs of the under parts of the body, which have fewer longitudinal grooves than those on the back. On the summit of the ridges the cuticle is thick and highly refractive, but how the cuticle is continued from one ridge to the next it is difficult to determine. In very thin sections the cuticle can be traced down the sides of the groove, becoming thinner and thinner, and disappearing at the bottom. The grooves would thus seem to be morphologically outside the hair. Yet it can be seen in many places that the grooves are not perfect, as if made with a plough, but are discontinuous; and each portion is canoe-shaped, open to the exterior at its middle, but covered in at the two ends. Sections taken across the end of such a segment of the groove show a continuous cover of cuticle (see *a*, fig. 8), and in surface view, with carefully stained specimens, the edges of the cuticular scales can be traced

across. It is no uncommon thing to find a ragged flap of cuticle overhanging the groove, as at *b* in fig. 8. These facts tend to show that the grooves are subcuticular; Welcker, in fact, goes so far as to state (17, p. 56) that the cuticle bridges over the grooves except in certain places, and his fig. 21 lends support to this view. And yet there is no denying the fact stated above, that the cuticle can be traced down the side of the groove. The logical conclusion, therefore, to which these facts point is that the grooves are morphologically intra-cuticular, a view which is in complete accord with the third suggestion offered in the case of the extra-cortex of *Bradypus*—that the cells are those of the cuticular layer, more numerous and less cuticularised than usual.

The hairs of *Cholæpus* are as a rule coarse, and with a single curve extending over the greater part of the length, while the basal fourth or so is wavy; but in young specimens, and in some apparently adult specimens from Costa Rica, the hair is very delicate and soft, and sinuous from base to point. The differences may be specific,¹ or due to age, season, or sex. However, in these forms the hairs are only about 42 μ across, and have only two or three furrows instead of the more usual nine, ten, or eleven. The algæ, also, are quite absent from many of the grooves. When such an empty groove is examined in optical section (fig. 12) it exhibits the outlines of obsolete extra-cortical cells, the edges of which are conterminous with those serrations of the margin which indicate the edges of the cuticular scales. In baby specimens more than half of the hairs are slender, non-medullate cylinders, with very distinct scaly cuticle, and no grooves on the surface. They are only slightly shorter than the two- or three-grooved hairs just referred to, and constitute the nearest approach to an under-fur found in *Cholæpus*.

¹ The species *didactylus* and *Hoffmanni* were supposed to differ in the number of cervical vertebræ. Although this distinction has broken down, *Cholæpus Hoffmanni* may still prove to be a good species. Until more accurate knowledge is available concerning the geographical range and internal anatomy of the so-called species of *Cholæpus* the point must remain open.

In *Cholœpus*, as in *Bradypus*, the hairs are very thin at their basal ends (60μ). The flutings of the surface die away on the basal sixth of the hair, and here the structure is that of a normal non-medullate hair (figs. 10 and 11). The cortex is not marked by the deeply staining branched tubes, but is rendered slightly granular by the presence of a number of fine air spaces, some spherical and scattered, some spherical and arranged in series of five or six, like strings of beads, and some fusiform, as though formed by the coalescence of such series of smaller cavities. The cuticle is thin and distinctly imbricate.

There are in *Cholœpus* no fine hairs to constitute a proper under-fur, and Welcker has remarked (17, p. 70), "Der Gegensatz von Stichelhaaren und Wollhaaren fehlt bei *Cholœpus*;" but de Meijere (9, p. 361) has described some flattened, stiff, and slightly curved hairs, much shorter than the ordinary hairs, and possessed of large medullary cells, surrounded by a very thin cortical layer. These hairs I have searched for in vain.

Myrmecophaga jubata.

The hairs of the great ant-eater are much flattened, and resemble a ribbon which is thinner in the middle than toward its edges. The actual measurements are—breadth 400μ , thickness in the middle 110μ , thickness near the edge 170μ . The cuticle is thin for the size of the hair, and exhibits, rather indistinctly, the usual imbricate or serrate appearance, according as a surface view or an optical section is taken. The cortex is full of air spaces (fig. 14), which are provided with a deeply staining lining after the manner of the branching tubes which permeate the cortex of the *Cholœpus* hair. These spaces, however, can hardly be regarded as a diffused medulla, since a true medullary region is here differentiated; and the suggestion made to this effect in the case of *Cholœpus* thus receives by analogy a partial refutation. When the hair is examined from the side the cortical vacuoles are

seen to consist of rows of six or seven spherical spaces arranged in the direction of the length of the hair. The middle spaces of each series are the largest, and the terminal ones the smallest, so that the general effect is that of a segmented spindle. In the pigmented parts of the hairs the pigment granules are disposed mainly around the smallest air spaces at the ends of the spindles. The central part of the hair is occupied by a slit-like air space partially filled with a highly refractive substance, which shows no traces of its cellular origin as the medulla so frequently does. The basal part of the hair is more cylindrical in shape than the middle part; and the medullary cavity dwindles gradually away, to disappear altogether in the part of the hair within the follicle, or just outside it. The basal parts are transparent, owing to the reduction in the number and size of the air vacuoles. A section of the hair taken about 3 mm. outside the follicle is shown in fig. 15.

Tamandua tetradactyla.

In this ant-eater the hairs are less coarse than in *Myrmecophaga*, and have the form of slightly compressed cylinders. The transverse section is oval in form, measures $140 \mu \times 90 \mu$, and exhibits a solid, non-medullate area of cortex, marked with numerous brown spots arranged in groups (fig. 16). The cortex is enclosed within a thick and tangentially stratified cuticle of clear, highly refractive aspect. Examined from the side the cuticle shows the usual imbricate markings. The basal part of the hair is more circular in section; it is free from the brown granules, and contains only a few scattered air spaces of minute size.

Cyclothurus didactylus.

The two-toed ant-eater has in addition to the principal hairs of the body a well-developed under-fur of much finer hairs. The whole pelage is soft and fluffy. The principal hairs, although much smaller than those of *Tamandua*, do

not differ from these in any essential respect. They have a fairly thick cuticle, but no medulla. They are broadest at about one sixth of their length from the free end, and in this part the cortex is coloured brown by numerous granules; whereas in the basal half or more these are wanting, and the hair appears quite clear, with just an odd air vacuole here and there.

The scaling of the cuticle is very strongly marked on the basal part of the hair, but in the pigmented portion it is less easy to distinguish. In the fine hairs of the under-fur the cuticular scaling is the most obvious feature. The greatest width of the larger hairs is 70μ ; that of the supplementary hairs 20μ . There is, however, no rigid distinction between the two kinds of hair, and transitional forms are fairly common.

Chlamydomorphus truncatus.

The soft fur of *Chlamydomorphus* is made up of fine non-medullate hairs, the average breadth of which is 17μ . The cortex is transparent and unpigmented, and contains only a few scattered granular markings. The scales of the cuticle project considerably, and give a ragged appearance to the surface of the hair (fig. 17).

Dasypus sexcinctus and *villosus.*

In both species the hairs are coarse, brown, and oval in section. When examined from the side they show a fine and close longitudinal striation, due to the arrangement of highly refracting granules in fusiform series. The cuticular scaling is close, and can be made out only with difficulty. In *Dasypus villosus* (fig. 19) the section is less perfectly oval than in *Dasypus sexcinctus* (fig. 18), since it tends rather towards the rectangle in shape. There is a distinct slit-like medullary cavity in *D. villosus*, but this is wanting

in *D. sexcinctus*;¹ the cuticle, also, is considerably thicker. In both species the granules in the cortex are most thickly set at some little distance from the margin, thus leaving a central part and a peripheral part of the cortex relatively clear. The long diameter of the oval measures about 230 μ in both species.

Tolypeutes conurus.

Tolypeutes has solid hairs provided with a thin, finely scaled cuticle. The minute structure very closely resembles that of the *Dasypus* hairs; in fact, except for their lighter colour, these hairs might be considered as of intermediate character between those of the two species of *Dasypus* examined. The sections are oval in shape (fig. 20), and there is a central clear area suggesting a medulla such as occurs in *Dasypus villosus*, but it has no cavity, and does not stain differently from the cortex. The cortex contains bright granules, not of a brown colour, disposed most thickly around the central clear space. Nearer the base of the hair the section is circular (fig. 22), and has no central clear area. The width of an average hair at its broadest part is 200 μ .

Tatusia novemcincta and *pilosa.*

The hairs of *Tatusia* are clear, solid, and non-medullate, with a sharply marked cuticular scaling and a very faint longitudinal striation. In transverse section the cortex appears very clear, and contains only a few highly refractive colourless granules (fig. 23). These are uniformly distributed, and are particularly scarce in *Tatusia novemcincta*. The sections of the hairs of *T. pilosa* are oval, and measure 115 μ \times 95 μ ; while those of *T. novemcincta* are circular in shape, and measure 130 μ across.

Mylodon Listai.

The hairs of *Mylodon Listai* are solid, and without any

¹ Lönnberg (7, p. 162) speaks of *D. sexcinctus* as though its hairs possessed a central pith.

trace of medulla. The width is very uniform, and measures $170\ \mu$ throughout the middle six eighths of the hair. The basal eighth is slightly narrower, and the free end tapers gradually to a blunt point, which is missing from most of the hairs. A perfect hair measures about 6 cm. in length.¹ The cortex would be quite clear and homogeneous but for the few short, fusiform air spaces, which are visible both from the side and in transverse sections. The vacuoles are uniformly distributed in all my preparations, and I have been unable to discover the peripheral clear zone of the cortex mentioned and figured by Jacob (4, p. 62 and fig. 2). Transverse sections from different parts of the hair are all similar in character (fig. 24).

The cuticle is moderately thick, and stains deeply. When the hair is examined from the side the cuticular scaling is very clearly observable on the basal third (fig. 25), but cannot be seen over the rest of the hair. This fact, together with a certain anxiety to make this ground sloth conform in its hair structure with the tree sloths, has led Lönnberg (7) to conclude that the hairs of *Mylodon Listai*, as we know them, are but the central cores of hairs which were provided, like those of *Bradypus*, with a more perishable extra-cortical layer. The fragments of adhering material, however, which he alludes to as the remains of the extra-cortex, are, judging by my own preparations, nothing but foreign matter such as dried mud or portions of the shrivelled root-sheath. On the basal part of the hair of the human head organic cellular substance, probably derived from the inner root-sheath, is commonly found attached to the cuticle long after that part of the hair on which it is found has emerged from the follicle. The fact of the cuticular scaling showing only on the basal part of the hair appears at first sight to support Lönnberg's view, for in *Bradypus* the extra-cortex

¹ The observations were made upon the specimen described by Smith Woodward and Moreno in 1899 (18). In a more recently discovered specimen, less well preserved, the hairs are much longer. See Smith Woodward (19).

is wanting on the basal part, and the scaling there is particularly clear. But in *Myلودon* the transition is very gradual, the scaling becoming fainter and fainter, and giving place to a uniformly stained external layer, whereas in a damaged *Bradypus* hair the scaling disappears in sharply outlined patches which do not stain at all.

Lönnberg writes (7, p. 162) that in tangential sections of the skin he saw around some of the hairs two rings, the outer of which was the epithelial hair-sheath, while the inner he took to be the "loose outer bark of the hair"—the extra-cortex, in fact. Since, however, in the fully grown hairs of neither *Bradypus* nor *Cholœpus* is the extra-cortex found within the follicle or anywhere near it, the argument fails to carry as much weight as he evidently intended it to do. His remarks on the following pages concerning the rings of dried epithelial substance around the exposed bases of the hairs are equally unfortunate. On the drying of the skin the hairs become protruded, and that region of each which in life was flush with the surface and closely surrounded by the general epidermis is pushed some distance out, a millimetre or so, dragging up the stratum corneum into the form of a cone. As the cone dries it cracks horizontally at a little below the summit, leaving an annulus attached to the hair. This is the kind of thing which can be seen by examining with a lens almost any museum skin of a mammal with a thick skin and stiff hair.

Again, a glance at the transverse section of the *Bradypus* hair taken through its broad part (fig. 3) is sufficient to show that, were the extra-cortex removed by disintegration or rough treatment, the central core would present a very ragged, unstainable edge, quite unlike the uniform, smooth, and deeply staining cuticular border of the transverse section of the *Myلودon* hair (fig. 24). And lastly, the reappearance of the cuticular scaling at the tip of the *Bradypus* hair (fig. 2) is not paralleled in the hair of *Myلودon*. The bulk of the evidence appears, therefore, to be against Lönnberg's theory, and we must consider the hairs of *Myلودon* to be preserved

to us in their completeness. They will bear a very close comparison with the hairs of *Tatusia* (fig. 23), and are not remarkably different from those of *Tamandua* (fig. 16) and *Dasypus sexcinctus* (fig. 18).

It is a curious fact that in all the American Edentates examined any characteristic features which each kind of hair may possess is absent from the basal portion. The basal parts of the hairs of *Bradypus* (figs. 5 and 6), *Cholæpus* (figs. 10 and 11), *Myrmecophaga* (fig. 15), and *Tolypeutes* (fig. 22) agree with one another, and furnish a generalised type of hair structure, with which the whole hairs of *Tatusia*, *Tamandua*, and *Dasypus sexcinctus* conform. Since the hairs of *Mylodon* are in such close agreement with this generalised type, it seems wiser to accept them as of primitive and generalised structure than to attempt to establish a parallelism between them and those of the tree sloths, especially in view of the fact that these latter are extremely aberrant, and differ so remarkably inter se. There is no need to conclude that *Mylodon* is the less a sloth, and more related to the ant-eaters and armadillos, because its hairs fail to possess an extra-cortex.

As regards the arrangement of the hairs in the skin there is not much to be said. The hairs are, as has been pointed out by Smith Woodward (18, p. 149) and Lönnberg (7, p. 164), all of one kind, there being no under-fur, and they are uniformly distributed, without any signs of symmetrical grouping. In *Bradypus* the follicles of the small hairs are clustered around those of the principal hairs, as Leydig (6, p. 707), Welcker (17, pp. 68—70, and pl. i, fig. 4), and de Meijere (9, p. 361) have shown; while in *Cholæpus* the hairs are arranged in bundles of two, though occasionally solitary, and there is no proper under-fur.

Appended to Dr. Sorby's remarks on *Bradypus* (15, p. 339) is a foot-note by the editor¹ of the 'Linnean Society's Journal,' which reads, "There is a small sloth, however, in which the larger hairs are smooth and solid." It is much to

¹ The late Mr. E. R. Alston.

be regretted that he did not mention the species he had in mind. The existence of a sloth with such hair would, of course, be of the greatest interest in the present connection, and so I examined the hair of every species of sloth available at the Natural History Museum. The results, however, do not enable me to confirm the editor's remark.

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3. ERDL, M.—‘Vergl. Darstellung des inneren Baues der Haare,’ ‘Abhandl. Akad. Wiss., München,’ iii, 1840—1843, pp. 413—453, three plates.
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EXPLANATION OF PLATE 26,

Illustrating Dr. W. G. Ridewood’s paper “On the Structure
of the Hairs of Mylodon Listai and other South
American Edentata.

al. Alga. *co.* Cortex. *cu.* Cuticle. *eco.* Extra-cortex. *m.* Medulla.

FIG. 1.—Bradypus tridactylus. Hair, one and a half times natural size.

FIG. 2.—Terminal portion of hair (A in Fig. 1). $\times 100$.

FIG. 3.—Transverse section taken through the thickest part of the hair (B in Fig. 1). $\times 100$.

FIG. 4.—Corresponding part of hair seen longitudinally; the upper part in optical section, the lower part with the surface in focus. $\times 100$.

FIGS. 5 and 6.—Transverse section and side view of basal part of hair taken in the position indicated by c in Fig. 1. $\times 100$.

FIG. 7.—Portion of one of the five hairs of the under-fur, and a transverse section of the same. $\times 100$.

FIG. 8.—*Cholæopus didactylus*. Transverse section through the middle of the length of the hair. The superficial grooves are occupied by shrivelled extra-cortex and alga. At *a* the groove is completely, and at *b* partially closed over by cuticle. $\times 150$.

FIG. 9.—Portion of the hair seen from the side. $\times 150$.

FIGS. 10 and 11.—Transverse section and side view of the hair at a point one eighth of the total length from the base. $\times 150$.

FIG. 12.—Optical section of a hair of a soft-furred specimen of *Cholæopus didactylus*, showing in the groove, which is in focus on the right side of the figure, the cell outlines of the extra-cortex. $\times 150$.

FIG. 13.—Transverse section of the same hair. $\times 150$.

FIG. 14.—*Myrmecophaga jubata*. Transverse section through the middle of the length of the hair. $\times 100$.

FIG. 15.—Transverse section through the hair at about 3 mm. above the surface of the skin. $\times 100$.

FIG. 16.—*Tamandua tetradactyla*. Transverse section through the middle of the length of the hair. $\times 150$.

FIG. 17.—*Chlamydophorus truncatus*. Hair seen in transverse section and from the side. $\times 600$.

FIG. 18.—*Dasypus sexcinctus*. Transverse section through the middle of the hair. $\times 100$.

FIG. 19.—*Dasypus villosus*. Transverse section through the middle of the hair. $\times 100$.

FIG. 20.—*Tolypeutes conurus*. Transverse section through the middle of the hair. $\times 100$.

FIG. 21.—Middle part of the hair seen from the side; upper part in optical section, lower part with the surface in focus. $\times 100$.

FIG. 22.—Transverse section through the hair at about one quarter of its length from the base. $\times 100$.

FIG. 23.—*Tatusia pilosa*. Transverse section through the middle of the length of the hair. $\times 150$.

FIG. 24.—*Mylodon Listai*. Transverse section through the middle of the hair. $\times 100$.

FIG. 25.—Portion of the hair about one quarter of the total length from the basal end; surface in focus to show the cuticular scaling. $\times 100$.

