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I. Wissenschaftliche Mitteilungen.

1. The Auditory Ossicles of Some African Rodents.

By T. D. A. Cockerell, L. I. Miller and M. Printz.

(With 11 figures.)

eingeg. 12. März 1914.

Some time ago we began an investigation of the Rodents of Colorado, with the idea of determining what generic and specific characters could be found in structures not usually alluded to in taxonomic work, and what variation was exhibited by the various parts of the body. In the course of this work we came to the auditory ossicles, and soon became convinced that these little bones were of great interest and value for taxonomic studies. In order to gain a wider acquaintance with the modifications exhibited, we borrowed African skulls from the U. S. National Museum, and a series of South American skulls from the American Museum of Natural History. The present short paper describes and figures the African specimens collected by the Smithsonian Expedition to British E. Africa.

Describers of rodents lay stress on the form and size of the external ear and of the auditory bullae. It is very easy to lay bare the auditory ossicles on one side, without seriously damaging a skull, and there seems

no reason why this should not be regularly done, for the purpose of adding to the specific and generic characters cited. On the whole, the ossicles appear to be quite conservative, large groups of rodents having them of the same general pattern. Thus, we figure (fig. 1) the malleus and incus of *Proechimys semispinosus*, from Colombia (Leo. E. Miller, Am. Mus. Nat. Hist.), which are almost identical in form with those of the African *Aulacodus*. On the other hand, good specific characters are not wanting; thus the malleus of *Epimys hindei* (fig. 2) is easily distinguished from that of *E. norvegicus*. In some cases unexpected affinities seem to be indicated; thus the ossicles of *Graphiurus* are more

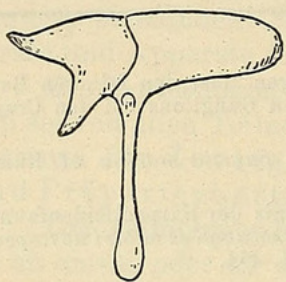


Fig. 1. *Proechimys semispinosus*. Colombia. (Am. M. N. H.) Leo E. Miller Coll.

like those of the squirrels than the true mice. The degree of modification or specialisation differs greatly, the most extreme form of malleus being apparently that of *Epimys*, a genus probably of comparatively recent evolution¹.

In the human ear, the end of the stapelial process (processus longus) of the incus is about on a level with the middle of the manubrium. In *Paraxerus* (fig. 3) and *Graphiurus* (fig. 4) the same general relation holds, though the bones are very different in detail. In the true mice, however (cf. *Dendromus*, fig. 5; *Arviacanthus*, fig. 6; *Thamnomys*, fig. 7) the incus is very short, and the stapelial process does not nearly reach the base of the manubrium. This would have the effect of strengthening the vibrations while decreasing their amplitude, and would give the animal an advantage in hearing notes of high pitch. Thus there appears to be a definite relation between the size and shape of the ossicles and the voice of the animals, although this can at present only be stated in general terms. The ossicles, then, exhibit a certain parallelism with recognition marks, probably tending to make the rodents especially sensitive to the voice of their species. Perhaps some day an energetic student will collect phonographic records of the voices of mammals, and it will be possible to determine more exactly how these are related to the structure of the ears. It may be also noted that the chirping Orthoptera, much preyed on by mice, often have very high pitched "voices", so much so that they are sometimes inaudible to some human beings. It may be advantageous to the Orthoptera to be able to call one another in notes so shrill that to some animals they are inaudible, but it may also be advantageous to the mice to be well fitted for hearing those high sounds.

The classic work on earbones is that of A. H. G. Doran, in Trans.

¹ We have more recently obtained evidence suggesting that this type is really an ancient one.

Linn. Soc. London, ser. 2, vol. 1, pp. 371—497, plates 58—64. In using this fine work it is necessary to remember that the appearance of the ossicles is very different in different positions; thus in our fig. 1 (*Proechimys*) the manubrium of the malleus appears to be a narrow rod, spatulate at the end, but in another view it is blade-like. It is for this reason that we have often given two views of the manubrium. We have used the term processus cephalicus (*p.c.* in figures) for the process which is directed downwards from the head of the malleus in Muridae, giving support to the lamina. The long process of the incus we call the stapedial process, to avoid possible confusion. Other abbreviations used in the figures are: *p.g.* = processus gracilis; *stap.m.* = stapedius muscle; *t.tym.* = tensor tympani; *orb.ap.* = orbicular apophysis; *p.m.* = processus muscularis (for tensor tympani); *lam.* = lamina.

Sciuridae.

Paraxerus jacksoni (fig. 3).

British E. Africa (E. A. Mearns). ♂. U. S. N. M. 162218.

Upper part of malleus subquadrate, with no processus gracilis; manubrium flattened, spatulate at end; processus muscularis, to which tensor tympani is attached, small, on inner border not very far from base. Stapedial process of incus not modified at end. Head of stapes broad and flat; crura slender; a bony intercrural canal. The malleus is formed much as in other Sciuridae, except that the angle representing the processus gracilis is much less developed than usual. The spatulate manubrium is like that of *Eutamias*. The incus is of ordinary form, but the stapedial process is peculiar for lacking any apical modification.

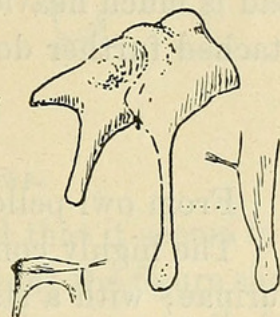


Fig. 3. *Paraxerus jacksoni*. Male. British East Africa. (E. A. Mearns). Nat. Mus. 162218.

The stapes is much like that of *Pteromys nitidus* as figured by Doran, and indeed the whole conformation of the bones suggests affinity with *Pteromys*.

Doran does not figure the ossicles of any member of the Xerinae, but notes that those of *Xerus setosus* are very similar to those of *Tamias striatus*.

Myoxidae.

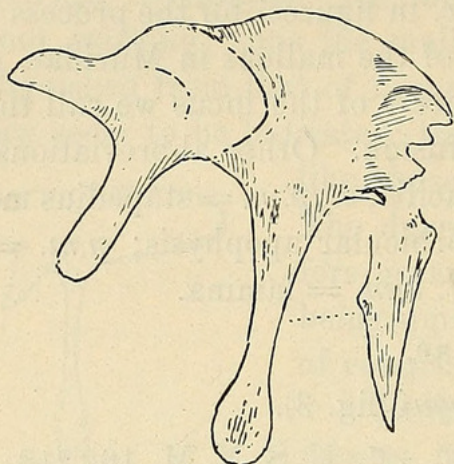
Graphiurus sp. (figs. 4, 4a).

W. side of Mt. Kenia, British E. Africa (J. A. Loring). Oct. 4. ♀. U. S. N. M. 164266.

Malleus nearly as in *Myoxus glis*, as figured by Doran; there is an imperfectly developed (apparently imperfectly ossified) lamina, bordered

by rudimentary processi cephalicus and gracilis, the arrangement approaching that of the Muridae; the manubrium is very strongly spatulate, but appears pointed in lateral view, when it shows the tubercular processus brevis in front at base, and a processus muscularis, slightly above the middle, behind. The incus has the processus brevis much

Fig. 4.



longer than in *Myoxus glis*, giving it a curious resemblance to the head of a pigeon. The stapes, with

Fig. 4a.

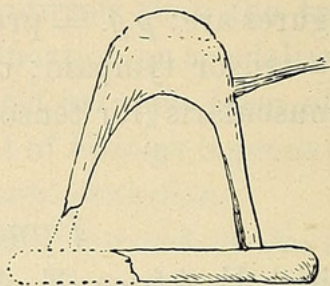


Fig. 4 and 4a. *Graphiurus* sp. W. side of Mt. Kenia. ♀. U. S. N. M. 164266.

straight (not arched) crura, is like that of *Myoxus glis*, except that the head is much heavier. There is an intercrural canal. The stapedius is attached further down than in *Paraxerus*.

Muridae.

Epimys hindei (figs. 2, 2a).

From owl pellet; Athi Plains, British E. Africa (J. A. Loring.)

The highly complicated malleus has the form characteristic of the Murinae, with a strong downwardly directed processus cephalicus, externally bounding the large semitransparent lamina. The orbicular apophysis of Doran is very well developed, and the processus muscularis, arising from the extreme base of the manubrium, is slender and elongated. Compared with *E. nor-*

Fig. 2.

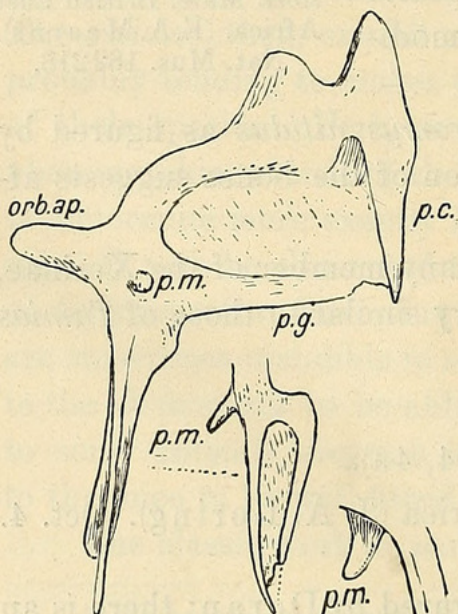


Fig. 2a.

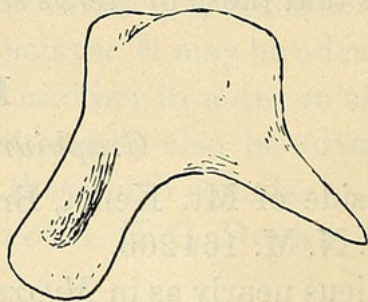


Fig. 2. Malleus of *Epimys hindei*. Athi Plains. Fig. 2a. Incus of same.

vegicus, the malleus is easily separated by the two tubercles (instead of only one) on the head above. The manubrium is similar to that of *E. norvegicus*. The stapedial process of the incus, as in *E. norvegicus*, is very large and broad; its outer surface is hollowed.

Lophuromys sp. (figs. 8, 8a).

Mt. Kenia, British E. Africa (E. A. Mearns). ♀. sept. 29. U. S. N. M. 163526.

The malleus is very peculiar, almost dagger-like, with a high handle-like head; the manubrium, while of ordinary shape, though rather short, is of similar consistency throughout, without the strong marginal ribs seen in *Epimys*; in the figure the manubrium appears very broad, but it is flat, and in one view looks like a slender rod; the lamina is rather

Fig. 8.

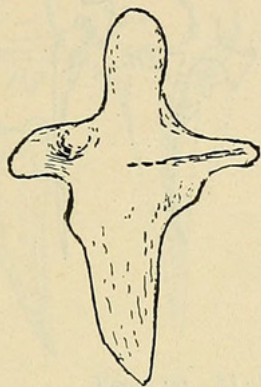


Fig. 8a.

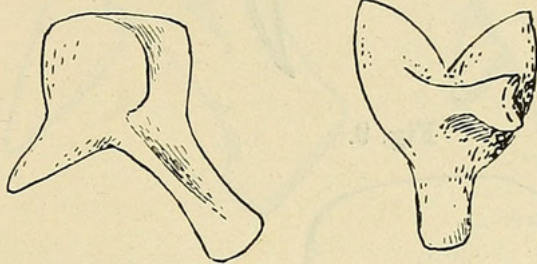


Fig. 8. Malleus of *Lophuromys*.

Fig. 8a. Incus of *Lophuromys*. Two views.

broad, but with its supporting processus so twisted that it seems to be absent when the ossicle is placed in the usual position; the figure shows this structure too short and blunt, the extreme tip being apparently lost.

The malleus of *Lophuromys* reminds one of that of *Geomys bur-sarius*, as figured by Doran, but it differs in the greater development of the lateral processes.

The incus of *Lophuromys* is peculiar; when placed so that the stapedial process is directed upwards, the upper or articular side appears strongly bifid, as shown in the figure.

Arviacanthus sp. (fig. 6).

Nguasso Nyiro, British East Africa (J. A. Loring). ♂. June 26. 1909. U. S. N. M. 162636.

The drawings show the ossicles in situ. It is interesting to compare them with the ossicles of the human ear, and note the extreme brevity, in comparison, of the stapedial process of the incus, which falls far short of the base of the manubrium. In the stapes, the stapedius muscle is inserted in the base of the posterior crus instead of in the side

of the head. A blood vessel, but no bony canal, goes between the crura of the stapes.

The ossicles of *Arviacanthus* are of a somewhat generalised murine type, but very distinctly murine. The resemblance to *Hydromys chrysogaster*, as figured by Doran, is quite close. So far as the ossicles go, one would associate the Hydromyinae with the Murinae, and certainly not put the Gerbillinae between.

Fig. 6.

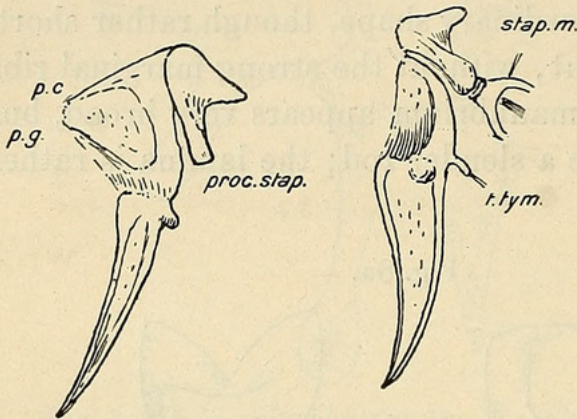


Fig. 9 a.

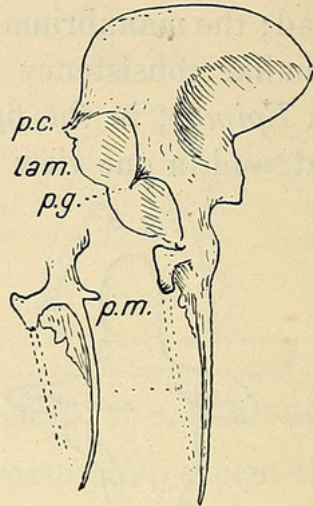


Fig. 9.

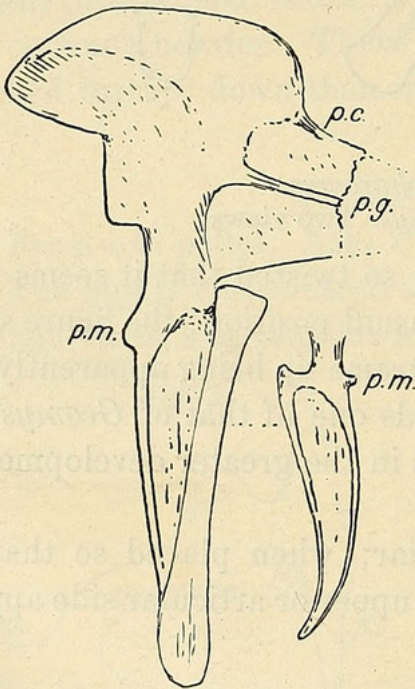
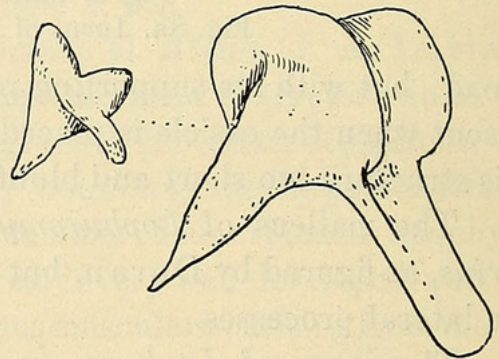


Fig. 9 b.

Fig. 6. *Arviacanthus*. 6430.Fig. 9. Malleus of *Tatera*. Athi Plains.Fig. 9 a. Malleus of *Tatera*.Fig. 9 b. Incus of *Tatera*. Athi Plains.

Tatera sp. (figs. 9, 9 a, 9 b).

From owl pellet; Athi Plains, British E. Africa.

The malleus is peculiar for the form of the head, as shown in the figure; but especially for the fact that the processus gracilis traverses

the middle of the lamina, as much of the lamina being below it as above. The incus is not unlike that of *Lophuromys*.

The head of the malleus suggests that of *Arvicola amphibius*, as figured by Doran.

Otomys sp. (figs. 10, 10a).

From owl pellet; Athi Plains, British E. Africa.

Contrary to expectation, the malleus of this genus has an entirely murine appearance, and is close to that of *Epimys*, though somewhat

Fig. 10.

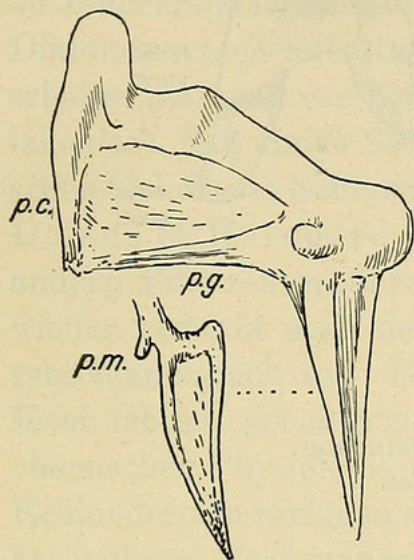


Fig. 10a.

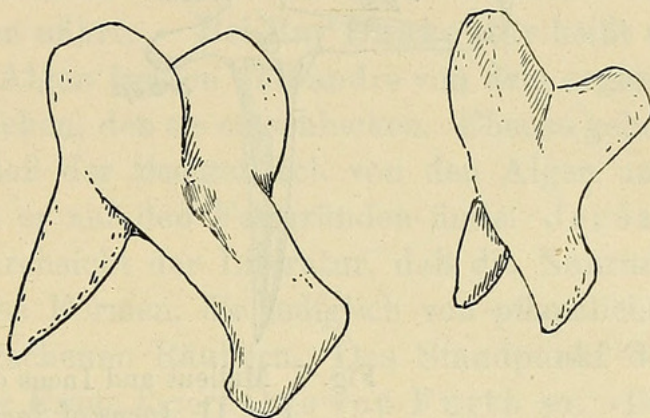


Fig. 10. Malleus of *Otomys* sp. Athi Plains.

Fig. 10a. Incus of *Otomys* sp. Athi Plains.

less specialised. The incus is less like that of *Epimys*, but not especially remarkable in any way.

Dendromus sp. (fig. 5).

Mt. Kenia, British E. Africa (J. A. Loring). ♂. Oct. 13. 1909. U. S. N. M. 164453.

The malleus is of the same type as that of *Hydromys chrysogaster*. The orbicular apophysis is strongly developed, even bulbous. The processus gracilis is rudimentary, the lower part of the lamina being practically without its support; but the processus cephalicus is strong, and directed downwards.

There is a strong general resemblance to the ossicles of *Arviacanthus*.

Thamnomys sp. (fig. 7)

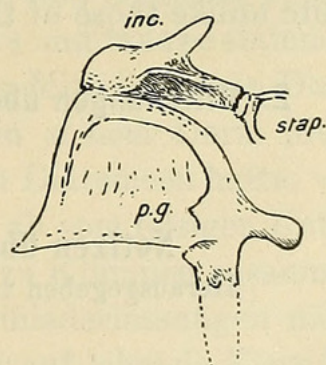


Fig. 5. *Dendromus*. 164453.

Lake Naiwasha, British E. Africa (J. A. Loring). ♂ July 21. 1909. U. S. N. M. 162524.

Another species with the *Hydromys* type of malleus; except for the *Epimys*-like orbicular apophysis, this ossicle is extremely like that of *Otomys*. The incus and stapes are ordinary; there is no bony canal between the crura of the stapes.

Fig. 7.

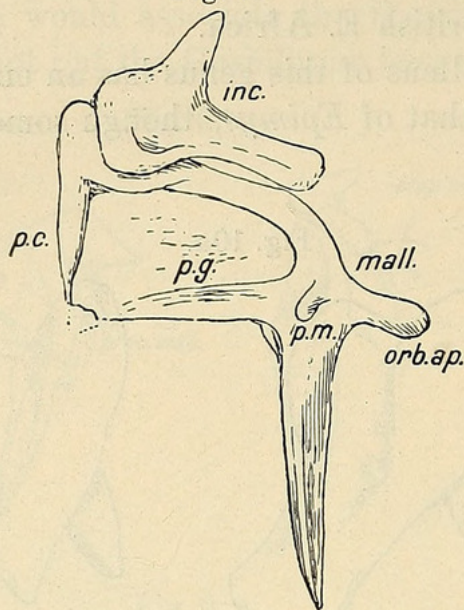
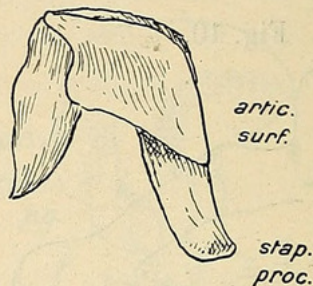
Fig. 7. Malleus and Incus of *Thamnomys*.

Fig. 11.

Fig. 11. Incus of *Tachoryctes*.

Bathyergidae.

Tachoryctes sp. (fig. 11).

British E. Africa.

In the specimen studied one malleus was broken and the other lost, the skull being old and weathered. Enough remains, however, to show that the arrangement is essentially as in *Bathyergus maritimus*, as described and figured by Doran. In *Bathyergus*, according to Doran, the malleus and incus are completely fused; in *Tachoryctes* this is not the case, and the incus is remarkable for a large, more or less flattened, surface for articulation with the malleus. The incus and malleus are quite unlike those of the muridae or the squirrels.

2. Mitteilungen über die Nahrung felsenbewohnender Seeigel der nördlichen Adria.

Von Thilo Krumbach.

Notizen über die Fauna der Adria bei Rovigno.

(Herausgegeben von der Zoologischen Station Rovigno in Istrien.)

(Mit 1 Figur.)

eingeg. 17. März 1914.

I.

Was die neueren Handbücher über die Ernährung der Seeigel mitteilen, ergibt ein widerspruchsvolles Bild. Bronns Klassen und Ord-



Cockerell, Theodore D. A., Miller, L I, and Printz, M. 1914. "The Auditory Ossicles of Some African Rodents." *Zoologischer Anzeiger* 44, 433-440.

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