

OCCASIONAL PAPERS OF THE MUSEUM OF
ZOOLOGY
UNIVERSITY OF MICHIGAN

ANN ARBOR, MICHIGAN

THE GLANS PENIS IN *SIGMODON*, *SIGMOMYS*, AND
REITHRODON (RODENTIA, CRICETINAE)

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COTTON rats (*Sigmodon* and *Sigmomys*), marsh rats, (*Holochilus*), coney rats (*Reithrodon*), and red-nosed rats (*Neotomys*) compose an assemblage which Hershkovitz (1955) considers to be natural and which he designates as the "sigmodont group." This group contrasts with oryzomyine, ichthyomyine, phyllotine, akodont, and other supraspecific assemblages which various authors (e.g., Thomas, 1917; Gyldenstolpe, 1932; Hershkovitz, 1944, 1948, 1955, 1960; and Vorontsov, 1959) have recognized in analyzing the large cricetine fauna of South America. While all of these groups are tentative, at least in regard to total complement of species in each, nevertheless some are strongly characterized and probably natural; and all, whether natural or not, are useful in that they constitute conveniently assessable segments of an unwieldy large South American cricetine fauna, now disposed in approximately 40 nominal genera. New information regarding three of those genera is provided below. It is derived from fluid-preserved and partially cleared glandes (procedures described by Hooper, 1959) as follows:

Reithrodon cuniculoides: Argentina, Tierra del Fuego, 1 adult. *Sigmodon alleni*: Michoacán, Dos Aguas, 3 adults. *S. hispidus*: Arizona, Pima Co., 1 subadult. Florida, Alachua and Osceola counties, 3 adults. Michoacán, Lombardía, 2 adults. *S. minimus*: New Mexico, Hidalgo Co., 1 juvenile. *S. ochrognathus*: Texas, Brewster Co., 1 subadult. *Sigmomys alstoni*: Venezuela, Aragua, 1 subadult.

I am indebted to Elio Massoia for the specimen of *Reithrodon* and to Charles O. Handley, Jr., for the example of *Sigmomys*. Figures 1 and 2 were rendered by Suzanne Runyan, staff artist of the Museum of Zoology. The National Science Foundation provided financial aid.

Listed below in sequence are representative measurements (in mm.)

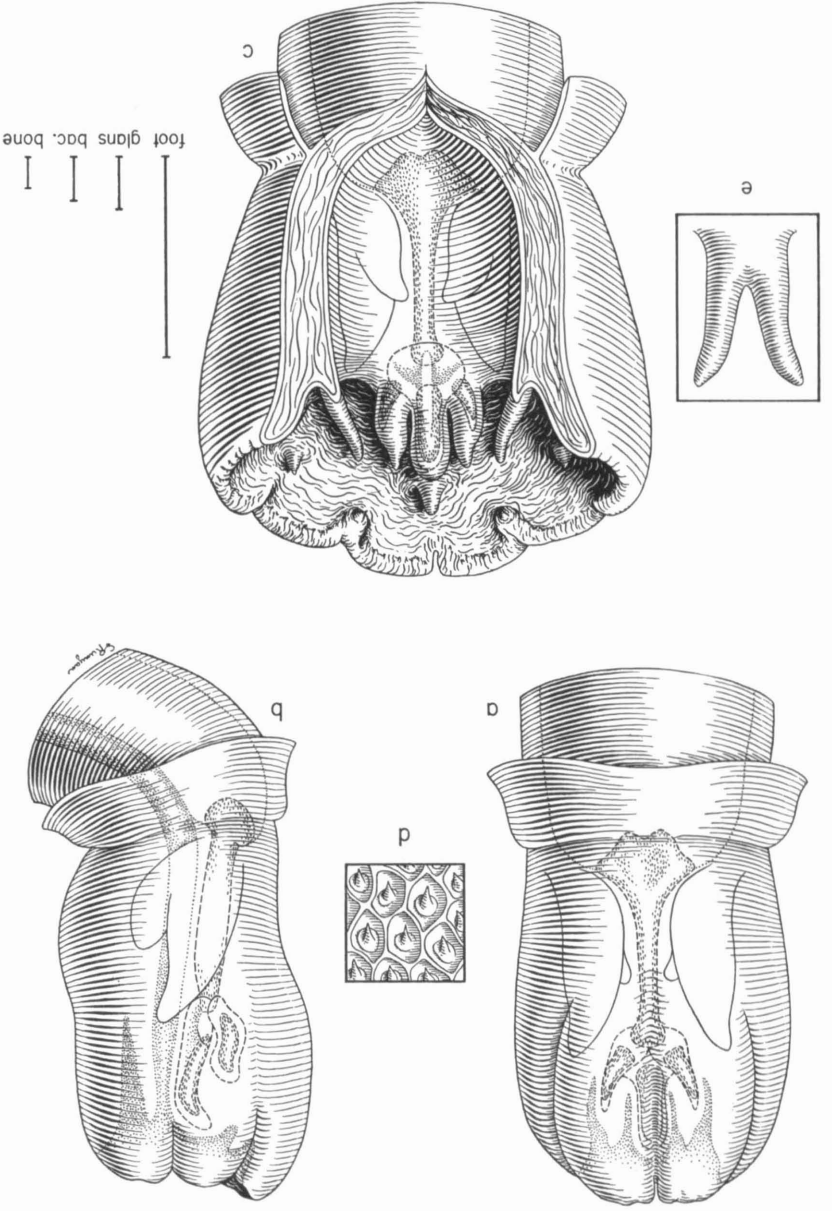
of *Sigmodon hispidus* (averages of five adults), *Sigmomys alstoni* (one subadult), and *Reithrodon cuniculoides* (one adult). Length of hind foot: 34, 30, 33; greatest lengths of glans, 7.6, 6.6, 7.8; greatest diameter of glans, 6.2, 4.0, 5.0; length of main bone of baculum, 5.5, 4.9, 4.1; length of medial distal segment of baculum, 2.8, 2.0, 2.7; total length of baculum, 8.3, 6.9, 6.8.

DESCRIPTION OF GLANDES

Sigmodon hispidus.—In *Sigmodon hispidus* the glans is a spinous, stubby, contorted cylinder (Fig. 1), its length one-fourth to one-fifth that of the hind foot and its greatest diameter approximately three-fourths its length (see measurements). The spines which densely stud almost all of the epidermis, except that of the terminal crater, are short and thick-set; each is recessed in a rhombic or hexagonal pit. The glans is somewhat swayback and potbellied, yet in its basal one-half or two-thirds it is essentially plain and cylindrical, without lobes or folds other than a short midventral frenum which, as an indistinct raphe, continues distad to the rim of the crater. The distal third or half of the glans is conspicuously hexalobate, the six lobes separated from each other by longitudinal troughs or grooves which increase in depth distad. The lobes are unequal in size and shape; the ventral pair is largest and the least convex, the lateral pair smallest, and the dorsal pair the most convex; the latter is a key item in the swayback appearance of the glans. These lobes converge distally, and their crescentic lips form the scalloped, overhanging rim of the terminal crater.

The largest structure in the crater is the mound which houses the medial distal segment of the baculum. Nestled between the lips of the ventral lobes, it projects outside the crater approximately to the limits of the dorsal lobes. The two smaller lateral mounds, housing the lateral processes of the baculum, are closely appressed to the medial mound, and the tip of each is distinctly pointed, rather than gently rounded like the medial mound. Immediately ventral to the medial mound is the meatus urinarius which is guarded ventrally by a urethral process. This process consists of a pair of rather thick arms each of which is out-curved and tapers to an obtuse tip (Fig. 1); in one specimen the ventral face of the process is studded with spines. Dorsal to the medial mound is the dorsal papilla, which is a single distensible cone of soft tissue dotted with spines both dorsally and laterally. Two additional pairs of crater conules, here termed "dorsolateral and lateral papillae," are particularly noteworthy because, insofar as known

Fig. 1. Views of glans penis of *Sigmodon hispidus*: a, dorsal; b, lateral; c, incised, midventrally exposing urethra; d, epidermal spines, enlarged; e, urethral process, enlarged, ventral aspect; UMMZ 97270, Florida.



in the New World cricetids studied to date, they are peculiar to *Sigmodon* and *Sigmomys*. All four of these are spine-studded, stubby, and smoothly rounded terminally. Each dorsolateral papilla is situated just below the crater rim at the junction of the dorsal and lateral lobes. Each lateral papilla is partly recessed in a pocket on the lower flank of the crater wall alongside a lateral bacular mound.

There is no ventral shield (a large mass of tissue between the urethral process and the ventral lip of the crater) as seen in most microtines, and the bacular mounds are relatively free within the crater, there being no partitions connecting the lateral mounds with the crater walls; the urethra empties onto the crater floor, not into a partition-encircled secondary crater within the larger crater, an arrangement seen in some rodent species.

Below the crater floor is a right and left pair of bilobed sacs (Fig. 1), each ovoid ventral lobe about 1.5 mm. in length, and each attenuate dorsal lobe approximately a millimeter longer, its tip extending distad almost to the limits of the main bone of the baculum. These sacs or sinuses emerge from tissues situated beside the corpora cavernosa penis and they extend alongside the baculum and the corpus cavernosum urethra, but they apparently are not parts of either of those structures. Composed entirely of soft tissues and engorged with blood in some specimens, they appear to be continuous with the deep dorsal vein and, thus, they seem to be part of the vascular system. Similar sacs, as illustrated in *Phyllotis* by Pearson (1958:424) for example, occur in all of those New World cricetids studied to date that have a four-part baculum; they have not been observed in *Peromyscus*, *Neotoma*, or other cricetid groups which are characterized by a simple baculum and glans.

The four-part baculum is at least as long as the glans and is one-fourth the hind foot in length (see measurements). The main bone, one-sixth the length of the hind foot, is angular and gross. The dorsal face of its wide and angular base is deeply concave between prominent lateral and proximal condyles to which the corpora cavernosa attach, while the ventral surface is almost flat except for a midventral keel of either cartilage or bone which, spanning approximately four-fifths the length of the bone, terminates at the cartilage of the digital junction. The shaft is oval in cross-section, the dorsoventral diameter exceeding the transverse one; as viewed laterally it is slightly bent and is constricted terminally, while in ventral view it is gently tapered distad before expanding to form a distinct terminal head.

The three distal segments of the baculum are subequal in length,

the lateral pair slightly shorter than the medial one. They differ considerably in shape and amount of ossification. In one breeding adult they are entirely cartilaginous, while in four other adults they contain various amounts of osseous tissue in addition to cartilage; probably in very old animals they are entirely osseous. The medial segment, attached to the ventral sector of the main bone, projects distad and slightly ventrad, then it bends abruptly dorsad before terminating in a rounded tip. It is approximately oval in cross section in its distal three-fourths, but in its proximal fourth it is much wider than deep and is keeled ventrally; moreover, at the digital junction it bears a pair of lateral processes and a medial flange, the continuation of the midventral keel, which extends over the ventral face of the head of the main bone. In all specimens at hand these three processes are cartilaginous; furthermore, the osseous tissue of the three distal segments is restricted to, or concentrated in, the distal parts of each segment, indicating that ossification apparently proceeds from the tip proximad in *S. hispidus*.

The lateral segments, situated dorsolateral to the medial unit, attach onto the dorsal and lateral parts of the head of the main bone—dorsal to the flanges of the medial segment. Each is pointed and blade-shaped, the dorsoventral diameter exceeding the transverse one; and as viewed ventrally each curves gently distad and slightly laterad. Whether cartilaginous or osseous, they are situated in the lateral parts of each bacular mound, while the medial and distalmost parts of each mound consist entirely of soft tissue, a large part of which is vascular and appears to be instrumental in distention of the mounds. In some examples, the basal parts of the three distal segments of the baculum are more or less coalesced; this is particularly true of the two lateral units, and the two have been interpreted as a single horn-shaped structure (Hamilton, 1946). However, as indicated by Burt (1960) they are separate units (Fig. 1); their individual limits are clear in specimens at hand.

Sigmodon minimus, *S. ochrognathus*, and *S. alleni*.—I recognize no interspecific differences in the specimens of *minimus* and *ochrognathus*, both examples of which are young and rather unsatisfactory. Each closely resembles specimens of *hispidus* of like age in external size and shape, and in conformation of the six exterior lobes, dorsal papilla, dorsolateral papillae, lateral papillae, urethral process, crater mounds, and baculum. If there are interspecific differences, they are not clearly evident in the material at hand.

The three adults from Dos Aguas, Michoacán, which are labeled *S.*

alleni, are also like adults of *hispidus*. The two series differ slightly in regard to size of glans and shape of baculum, but these are small differences and doubtfully interspecific.

A few remarks regarding the identification of the specimens from Dos Aguas are needed. Until variation in *Sigmodon* is better understood, *S. alleni* seems to be the most appropriate name to apply to these specimens and, as well, to others like them from the vicinity of Autlán, Jalisco, and Angahuan and Uruapan, Michoacán. Cranially and externally distinguishable from specimens of *S. hispidus* and *S. melanotis* from nearby localities in the same states, they appear to represent a species other than either *hispidus* or *melanotis*. They agree well with the description of *alleni*, but they have not been compared directly with the type specimen of that form.

Sigmomys alstoni.—The specimen of *Sigmomys alstoni* resembles examples of *Sigmodon* of comparable age in length (relative to hind foot), in external configuration (hexalobate, swaybacked and potbellied in lateral view, and covered with proximally directed, thickset, sharp, entrenched spines), shape of dorsal papilla (single, spine-studded cone), appearance of urethral process (two outcurved arms with a longitudinal row of spines on the ventral face of each), shape of the bacular mounds (the medial one large and rounded, each lateral one smaller and rounded laterally but acute medially), position of digits of baculum with respect to the main bone, presence of ventral keel and lateral arms on the medial digit, and occurrence of a midventral keel on the main bone. The specimen differs from examples of *Sigmodon* in characters as follows: glans smaller in diameter (diameter-length ratio approximately 60 per cent, compared with 70–88 per cent in *Sigmodon*); the six external lobes, particularly the dorsal pair, less prominent; dorsolateral papillae smaller, scarcely more than the spine-studded infolding of the dorsal and lateral lobes; crater more extensively spinous (spines studding most of inner wall of each lateral lobe); medial digit of baculum projecting principally distad, its tip not sharply flexed dorsad; and the osseous proximal segment flatter and wider for a larger fraction of its length.

The lateral papillae and baculum warrant additional comment. It is uncertain whether lateral papillae are present in the specimen. Two papillose vascular cores occur at sites where papillae are to be expected, but in the present damaged specimen the overlying crater floor is not correspondingly papillose, although it is strongly spinous; the spiny area occupies most of the inner face of the lateral lobe and of the adjoining crater floor. On the left side of the specimen this

roughly circular spiny area is plate-like, while on the right side it is buckled distad and, thus, resembles a large papilla. If, in undamaged specimens, these areas are papillose, then the lateral papillae in *S. alstoni* are relatively larger than any yet seen in *Sigmodon*.

In ventral view, the main bone of the baculum is shaped roughly like an isosceles triangle—wide basally and tapered rather evenly distad (without pronounced incurve) almost to the slight constriction which subtends the small, round, terminal head. Its wide basal part is concave dorsally (between low lateral condyles) and almost flat ventrally; but farther distad the bone is deeper than wide and, somewhat triangular in cross section, it bears a slight midventral ridge to which a cartilaginous keel is attached. The distal segments are entirely cartilaginous. The medial one is deeper than wide in its distal half and blunt terminally; basally it bears a medial process and two lateral flanges. Each lateral segment, also deeper than wide and blunt terminally, is situated dorsolateral to the medial unit.

Reithrodon cuniculoides.—The glans of *R. cuniculoides* (Fig. 2) is stubby (diameter-length ratio 64 per cent), subcylindrical, and indistinctly lobate, the lobes defined by four, shallow, longitudinal troughs. Two of these depressions, one situated middorsally and the other midventrally, extend approximately the full length of the glans and thereby divide the surface of the glans into right and left halves; the distal limit of each is a notch in the crater rim. The shorter third pair of troughs is situated dorsolaterally in the distal half of the glans, but each terminates short of the rim. All of the epidermis as far distad as the crenate, membranous, overhanging rim of the crater is densely studded with small, conical, recessed tubercles.

The three bacular mounds, together with the underlying baculum, resemble a fleur-de-lis in ventral aspect (Fig. 2); the erect medial part extends beyond the crater, while each of the truncate lateral pair sends off an attenuate lateral segment which curves laterad and then distad before terminating in an acute tip. These lateral processes contain no cartilage or bone; they consist entirely of soft tissues, a large part of which is vascular and apparently erectile. The spine-tipped dorsal papilla is unusually small and slender; it is a single cone, but a slight cleft near its tip suggests that the papilla may consist of two conules in other specimens. The urethral process is a bilobed flap with two attenuate and erect (not outcurved) arms; it bears two longitudinal rows, each of eight tubercles, on its ventral face. There are no lateral or dorsolateral papillae, and the crater walls and floor are smooth and non-spinous.

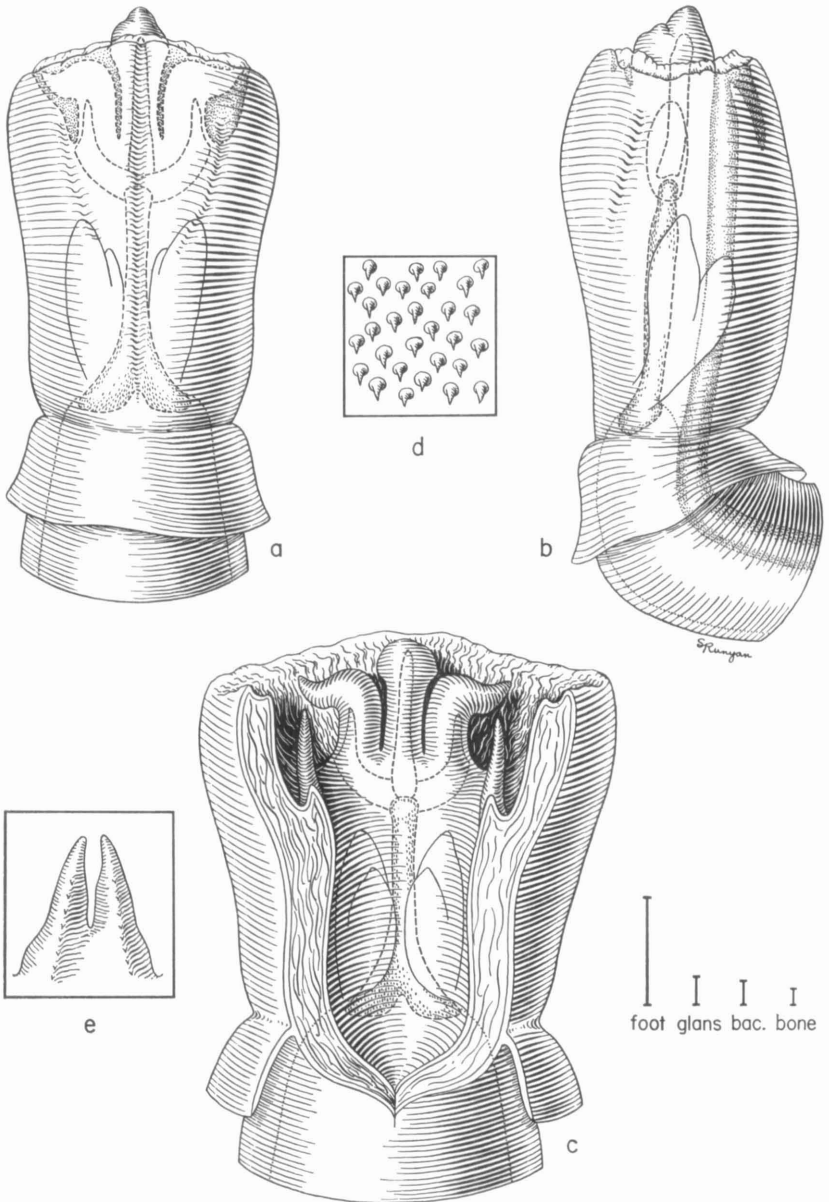


FIG. 2. Views of glans penis of *Reithrodon cuniculoides*; UMMZ 109233, Argentina. For explanation see Fig. 1 and text.

The baculum is shorter than the glans (see measurements). Its proximal, osseous segment consists of a wide basal part and a slender shaft. The basal part, which bears large, proximally directed condyles (these separated medially by a deep notch), is broadly concave ventrally and narrowly and shallowly concave dorsally. The relatively straight shaft is slightly deeper (dorsoventrally) than wide and it bears a slight ventral keel; its terminal portion is slightly expanded laterad and slightly constricted dorsoventrally (Fig. 2). The three distal segments are cartilaginous. The long medial one (its length two-thirds that of the bone) is rod-like for much of its length, but it is enlarged basally and is tapered distally to a pointed tip. The lateral units are disc-shaped in cross section, the dorsoventral diameter of each much greater than the transverse one. From its attachment on the head of the bone (the attachment dorsal and lateral to that of the medial unit) each lateral segment curves gently laterad and distad before it terminates at the base of the laterally projecting process of its lateral mound.

DISCUSSION

To judge from specimens at hand, the glandes of *Sigmodon alleni*, *S. hispidus*, *S. minimus*, and *S. ochrognathus* are fundamentally alike, although they may differ interspecifically in details which can not be appraised in present samples. In each species the stubby, swayback, tubercle-invested glans bears six prominent exterior lobes which surround the terminal crater and divide its rim into six corresponding parts. Within the crater there are five spine-studded papillae consisting of dorsolateral and lateral pairs in addition to a single cone mid-dorsally. The urethral process bears two attenuate, outcurved arms. The bacular mounds are truncate except for a small, acute medial crest on each lateral mound, and the medial distal segment of the four-part baculum bears a medial keel and a pair of lateral processes on its base, while its tip is flexed sharply dorsad. These characters, together with others, distinguish *Sigmodon* from the other New World cricetid genera which have been studied to date, with the possible exception of *Sigmomys*. *Sigmomys alstoni*, the only species of *Sigmomys* about which there is information on the glans, appears to be closely similar to species of *Sigmodon*, but its characters are not yet adequately known.

In contrast to the phalli of *Sigmodon* and *Sigmomys*, the glans of *Reithrodon cuniculoides* is comparatively slim and simple. There are only four exterior lobes, and these are less prominent than the lobes of *Sigmodon* or *Sigmomys*. The membranous, crenate, and non-spiny

crater rim is not divided into six distinct lobes. The crater, also smooth and spineless, has no dorsolateral or lateral papillae. The slender dorsal papilla bears spines only at its tip. Each lateral mound has an attenuate lateral process, and the entire configuration of the three crater mounds as well as of the underlying baculum is distinctive. The three, long, erect distal segments of the baculum, all cartilaginous insofar as known, are essentially rod-like in form, without prominent keels or processes. These and other contrasting characters indicate that the glans of *R. cuniculoides* is morphologically quite different from that seen in *Sigmodon* and *Sigmomys*. Preliminary comparisons suggest that it may be more similar to glandes of phyllotine or other species which are not now included in the sigmodont group of rodents.

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Accepted for publication February 5, 1962

