NEST-BUILDING BEHAVIOUR IN *AETHOMYS CHRYSOPHILUS*, *PRAOMYS (MASTOMYS) NATALENSIS* AND *RHABDOMYS PUMILIO*

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INTRODUCTION

Although nest-building is one of many important activities conducted by rodents, it has seldom been subjected to systematic observation. This holds particularly for rodent species indigenous to Africa. The purpose of the present work was to study nest-building in three African rodent species, *Aethomys chrysophilus* (African rat), *Praomys* (*Mastomys*) *natalensis* (multimammate rat) and *Rhabdomys pumilio* (striped mouse). For details concerning the distribution and morphology of these species, Davis (1968) and Misonne (1968) may be consulted.

An attempt was made to determine the amount of nest-building in both sexes of each species, at different temperatures. The technique employed was essentially that used by Layne (1969) for three *Peromyscus* species. An additional series of experiments was included in order to gain some knowledge of the natural preference for certain nest-building materials in each species. An evaluation of nest-building behaviour as a thermoregulatory function was also attempted in view of observations made by Kinder (1927) and Sealander (1952).

MATERIAL AND METHODS

Test animals were bred from wild stock collected around Pretoria, except for *Aethomys* which came from Tshipese. Several generations of each species tested had been raised in captivity. All mice tested were mature animals. Pregnant or lactating females were excluded from the experimental groups.

Two types of test were employed. One involved the amount of cotton removed per twenty-four hours from a container and the type of nest constructed. The other concerned preference for certain nesting materials.

For the cotton-removal tests the mice were housed individually in plastic cages with wire lids (mesh size 1,5 × 8 cm) and with dimensions of 43,2 × 27,9 × 22,9 cm. A tin can attached to the wire lid served as the container. A known weight of cotton was placed inside the container and the mouse obtained the cotton by pulling it through the mesh. The amount removed each day was determined to the nearest 0,1 gm. The floors of the cages were covered with 2–3 cm of ground mealie stalks. Food and water were provided *ad lib.*

Nests constructed with the cotton obtained from the container were classified into four categories. The types recognized are: no, or aberrant nest; platform—a simple flat pad without sides; cup—sides present but not roofed over; closed—a hollow, spherical nest completely roofed over.

In the material-preference experiments subjects were tested in an aquarium with inside dimensions of 61 × 31 × 31 cm. The aquarium was covered with a close-fitting hardboard cover with several small holes to ensure adequate ventilation. Dry sand 1–2 cm deep was used as a floor cover. A water-bottle was placed in one corner and the food placed in a cup in the middle

of the aquarium. The dispenser apparatus, size 14 × 8 × 21 cm, was placed in the aquarium and reached to 10 cm from the bottom of the aquarium. The inside of this dispenser was divided into three sections by means of hardboard partitions, in which cotton, white crêpe paper and "wood wool" respectively were placed. A known amount (in grams) of each was provided every twenty-four hours and the mouse obtained the material by pulling it through a one-centimetre diameter mesh wire netting covering the bottom of the dispenser. The crêpe paper used was cut into strips of approximately 13 × 1 cm. The amount of each type removed from the dispenser each day was determined. The type of nest constructed was recorded daily. As criteria for "nests", we took

1. material definitely bunched or gathered together and
2. evidence that the nest had been used. Mice of all three species were tested, one at a time.

Cotton-removal tests were conducted at 10°C and repeated at 20°C and 30°C. All material-preference tests were done at approximately 24°C.

In both cotton-removal and material-preference tests subjects were allowed three days acclimatization to the cage and container without cotton, and aquarium and dispenser-apparatus without material, respectively, and then tested for three days in the case of *Praomys* and *Rhabdomys* at 10°C and for four days in every other case. Nest-building material used each day in both series of experiments was removed the next day.

All nest-building experiments were conducted within a 13:11-hour light-dark cycle. Relative humidity was not experimentally controlled; at 30°C free water was placed inside the room to prevent the air from becoming too dry.

Data concerning the animals utilized in the cotton-removal experiments are given in Table 1. In the material-preference experiments three individuals of each species were tested.

TABLE 1

ANIMALS TESTED, OPPORTUNITIES GIVEN FOR NEST-BUILDING AND NUMBER OF NESTS BUILT IN COTTON-REMOVAL EXPERIMENTS

		TEMPERATURE (IN °C)								
		10			*20*			*30*		
Species	*Sex*	*Animals*	*Opportunities (all animals)*	*Nests*	*Animals*	*Opportunities (all animals)*	*Nests*	*Animals*	*Opportunities (all animals)*	*Nests*
Aethomys	Male	3	12	12	3	12	12	3	12	12
	Female	3	12	12	3	12	11	3	12	12
Praomys	Male	2	6	4	2	8	4	2	8	0
	Female	2	6	3	2	8	4	2	8	4
Rhabdomys	Male	2	6	6	2	8	8	1	4	3
	Female	4	12	12	4	16	16	3	12	11

TABLE 2

MEAN MASS (IN GRAMS) OF COTTON USED FOR NESTING MATERIAL DURING EACH TESTING PERIOD AND STANDARD DEVIATIONS OF MEANS FOR MALES AND FEMALES, DEGREES OF FREEDOM AND T-VALUES OBTAINED IN T-TESTS IN COTTON-REMOVAL EXPERIMENTS

		10°C				*20°C*				*30°C*			
Species	*Sex*	*Mean*	*S.D.*	*df*	*t-value*	*Mean*	*S.D.*	*df*	*t-value*	*Mean*	*S.D.*	*df*	*t-value*
Aethomys	Male	7,80	3,75	22	2,984†	2,54	2,28	22	−0,914	2,37	1,69	22	−0,955
	Female	4,18	1,91			3,38	2,22			3,60	4,13		
Praomys	Male	3,35	3,61	10	−0,086	1,56	2,14	14	−0,457	0,01	0,04	14	−2,260*
	Female	3,60	6,16			2,11	2,65			1,85	2,30		
Rhabdomys	Male	5,57	2,64	16	−0,176	5,25	2,54	22	4,119†	0,88	0,39	14	−2,303*
	Female	5,77	2,08			2,18	1,15			2,02	0,95		

* Significant sex difference (α=0,05).
† Highly significant sex difference (α=0,01).

TABLE 3

MEAN MASS (IN GRAMS) OF PAPER, COTTON AND "WOOD WOOL" REMOVED FROM DISPENSER AND MEAN AMOUNTS USED IN CONSTRUCTION OF NESTS DURING MATERIAL-PREFERENCE EXPERIMENTS

	Paper		*Cotton*		*"Wood wool"*	
Species	*Removed*	*Used*	*Removed*	*Used*	*Removed*	*Used*
Aethomys	5,30	3,31	0,05	0,01	1,48	0,91
Praomys	14,58	9,67	0,00	0,00	4,12	3,16
Rhabdomys	0,22	0,05	0,96	0,30	0,32	0,00

RESULTS

Cotton-removal experiments

The mean daily amounts of cotton taken (in grams) by males and females of the three species are summarized in Table 2.

The data, when statistically compared, show significant differences between males and females for *Aethomys* at 10°C, *Rhabdomys* at 20°C and 30°C, and *Praomys* at 30°C (α=0,05, t-tests). The differences are highly significant (α=0,01, t-tests) only in the first two of the above-mentioned four cases (Table 2).

At species level, in all experiments at the three different temperatures, *Praomys* removed the least cotton while *Aethomys* removed slightly more cotton than *Rhabdomys*. There was a general decline in amount of cotton removed as temperatures rose from 10°C to 30°C. The percentage distribution of the types of nests constructed by each species at the different temperatures is given in Figures 1, 2 and 3. The degree of nest-building success as shown in the number nests built in comparison to the number of opportunities given, can also be derived from data given in Table 1.

Except in *Rhabdomys* at 20°C and perhaps *Aethomys* at 10°C, females built better nests than males at the three temperatures tested for. The nest-building level, as reflected in the type of nest constructed, declined in general from 10°C to 30°C. *Rhabdomys* most frequently constructed the best type of nest, while *Praomys* generally built the poorest nest. In most cases the latter performed no nest-building at all and even at low temperatures only a small proportion of the animals built spherical-type nests.

Material-preference experiments

Table 3 gives the mean mass (in grams) of the different nesting materials removed from the dispenser by three individuals of each species.

Praomys (*Mastomys*) removed most material, followed by *Aethomys*, with *Rhabdomys* lagging far behind. Paper strips were preferred by *Aethomys* and *Praomys* while cotton was practically ignored. *Rhabdomys*, however, preferred cotton. Since the amount of nesting material actually utilized in constructing the nest is less than the amount removed, additional observations are given in Table 3. The added data were arbitrarily determined to a certain extent, since it was difficult to decide in a few cases whether or not the material used represented a nest. All the animals scattered or fragmented material in every test. Nests were built only in corners of the aquarium.

Aethomys always built neat, well-defined, cup-like nests of paper strips, and in a few cases used both strips and "wood wool". *Praomys* preferred paper strips but in some cases "wood wool" was also used to construct the nest. *Praomys* constructed clearly defined nests in 75% of the cases while in the other cases nesting material (strips) was gathered into abnormally large "nests", and in some cases more than one nest was built but only the largest was actually used. Only in 20% of the tests did *Rhabdomys* construct a neat spherical or cup-like nest of paper strips and/or cotton. Otherwise they built no nests, yet some material was always removed from the dispenser.

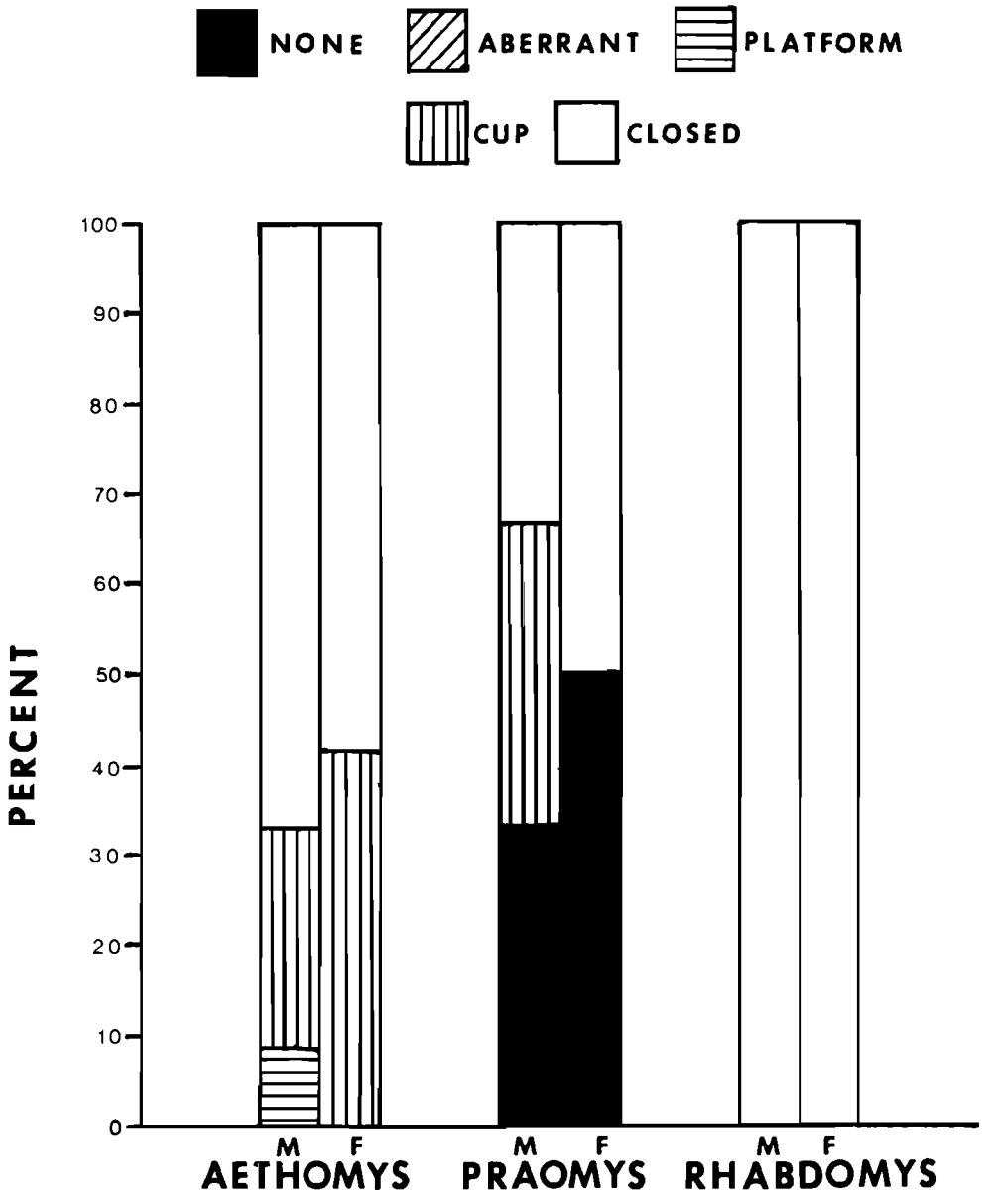

FIGURE 1

Percentage distribution of types of nests constructed at 10°C.

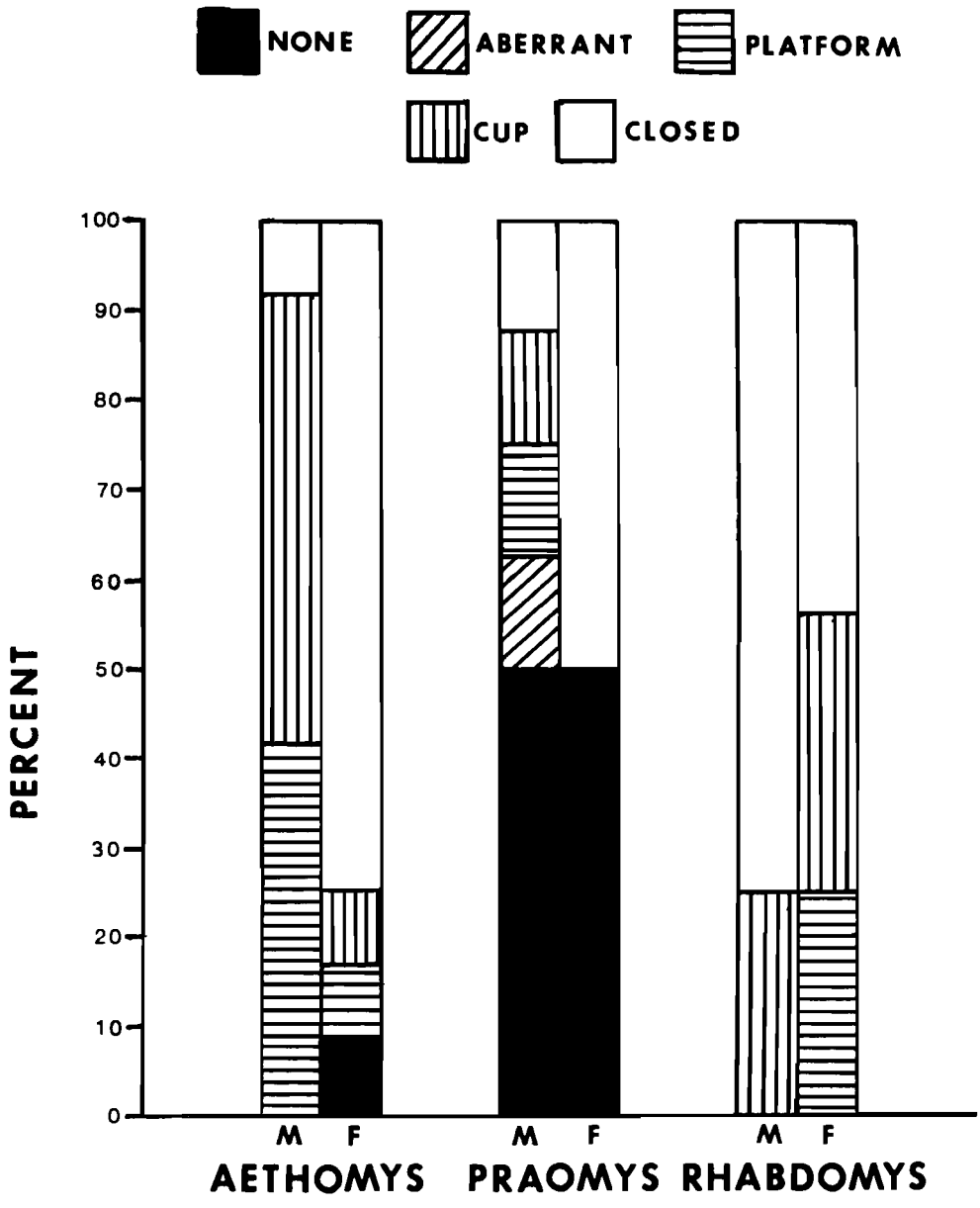

FIGURE 2

Percentage distribution of types of nests constructed at 20°C.

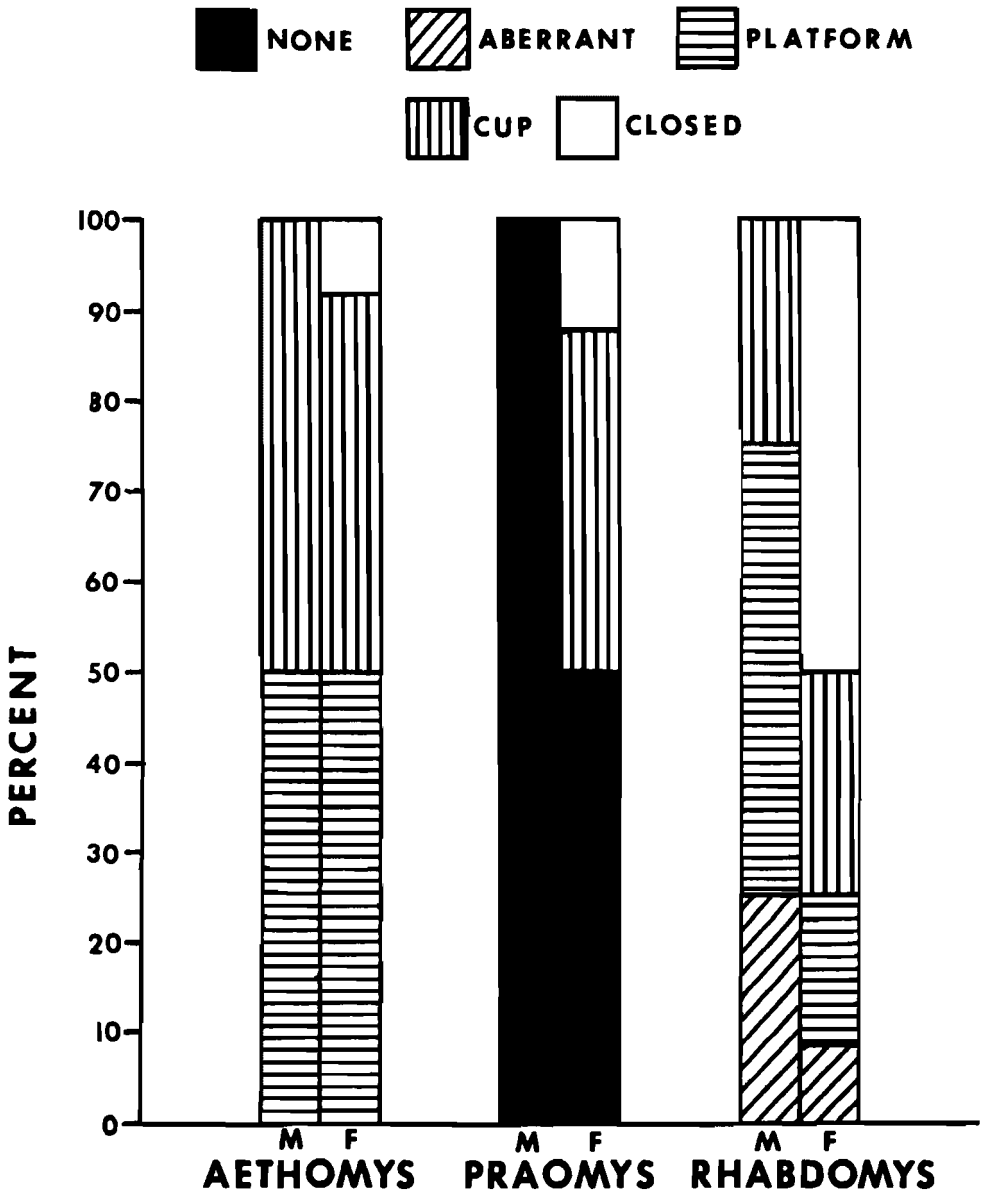

FIGURE 3

Percentage distribution of types of nests constructed at 30°C.

DISCUSSION

The results of the cotton-removal tests indicate that there are significant differences between the nest-building level of males and females as reflected in the amount of cotton removed in each of the three species at either temperature tested for (see above). The females tended to remove slightly more cotton per day than males, although the reverse was statistically proved in two cases (*Aethomys* at 10°C and *Praomys* at 20°C).

Regarding the type of nest built, females showed a general tendency to build better constructed types than males.

Layne (1969) reported no pronounced sex difference in nest-building level in laboratory groups of eight stocks of two species of deer-mice (*Peromyscus*), although males showed a slightly lower level than females. Essentially the same was found by Kinder (1927) in the albino rat. The data from the six groups presented in this study show a general correlation between differences in nest construction and amounts of cotton removed. This correlation may have been expected since the greater amounts of cotton removed at colder temperatures were used in better constructed nests and very little or no scattering of material was observed.

Even though it can be argued that preference for a certain nesting material (e.g. paper strips) reflects the ease with which it could be removed from the container, the apparent preference for paper strips by *Aethomys* and *Praomys* (*Mastomys*) and for cotton by *Rhabdomys* may best be explained by the nature of the nesting material as such. This may also account for the weaker performance of *Praomys* especially in the cotton-removal tests. It is possible that paper resembles the natural nesting material of *Praomys* and *Aethomys* (grass shreds) to a larger extent and hence was used more often. Even "wood wool" probably shows a closer resemblance to the natural nesting material than cotton, which was practically ignored by both *Praomys* and *Aethomys*. The reverse may be true in the case of *Rhabdomys*.

The phenomenon of material scattering and shredding, which always occurred in the preference experiments, may be the result of nervousness or a displacement activity as suggested by Layne (1969), or of a boring environment (Kiley, *pers. comm.*). In addition, the big space inside the aquarium permitted wild running which could have served as an outlet for surplus energy. Scattering could easily have occurred during this activity. Wild running and attempts to escape can disturb nest-building activity. The weaker performance of *Rhabdomys* in the preference tests in comparison to that in the cotton-removal experiments (cotton used in the one series and shown to be preferred in the other) can be explained in this way.

Scattering may also be the result of appetitive exploratory behaviour—material is removed from the container and on inspection found unsuitable as insulating material for the construction of the nest. This explanation seems strengthened when we take into account that very little or no scattering occurred in the cotton-removal tests where no choice was given and material provided had to be used for building a nest, especially under cold conditions.

This leads to the suggestion made by Sealander (1952) that protection offered by the nest is of definite survival value under conditions of extreme cold. It becomes important with reduction in activity and food consumption. It becomes even more important in the present study because subjects were tested individually and huddling therefore was impossible. Sealander (1952) states that in addition to nest-building, huddling constitutes a thermoregulatory activity which is

enhanced at low temperatures and reduced at high temperatures.

The results of the present work demonstrate that nest-building may be considered a thermoregulatory activity. This can be concluded from the larger amount of cotton removed and better type of nests built under colder experimental conditions while the reverse occurred at higher temperatures, e.g. at 10°C *Rhabdomys* constructed spherical nests in all cases, at 20°C in 59,4% of the cases and at 30°C in only 25% of the cases; at 30°C *Praomys* built no nest at all in almost 75% of the cases, at 20°C in 50% and at 10°C in 41,7% of the cases. Furthermore, of the total of 169 nests constructed in both series of experiments, 149 were placed in corners of the cage or aquarium and 13 against the sides. This strongly supports the observation made by Kinder (1927) that nesting positions selected by the albino rat were those where the air circulation was at a minimum. On the other hand corners may be chosen because of the better protection offered to the nest, or the greater ease of construction in this locality.

In conclusion the results obtained in this study should be seen only as an indication of the nest-building behaviour of *Aethomys*, *Praomys* (*Mastomys*) and *Rhabdomys*. More accurate and reliable evaluations can only be made with bigger samples of both laboratory and field subjects.

SUMMARY

Nest-building behaviour of three rodent species, *Aethomys*, *Praomys* (*Mastomys*) and *Rhabdomys* was studied. Comparisons between the three species were made at 10°C, 20°C and 30°C on the basis of daily amount of cotton removed from a container. The performance of males and females of each species is also reported. In an additional series of experiments the preference shown by each species for certain materials in nest-building was determined at approximately 24°C.

Rhabdomys removed most cotton and built the best type of nests. The reverse was true of *Praomys* (*Mastomys*). No significant difference in nest-building activity between males and females of any species was observed except for *Rhabdomys* at 20°C, *Aethomys* at 10°C, and *Praomys* and *Rhabdomys* at 30°C. All three species showed a general decline in the nest-building level from 10°C to 30°C.

Aethomys and *Praomys* preferred paper strips, and "wood wool" to a lesser extent, in the construction of their nests, while *Rhabdomys* used cotton most frequently. Scattering of material, which regularly occurred, is explained as the result of appetitive behaviour and wild running.

The thermoregulatory function of the nest was demonstrated by the better type of nest built at lower temperatures and poorly constructed types at higher temperatures, as well as by nesting positions selected—nests were usually constructed in corners or against the sides of the cage.

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