

EARLY POSTNATAL DEVELOPMENT OF THE SOUTH AFRICAN HAMSTER *MYSTROMYS ALBICAUDATUS*

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INTRODUCTION

The South African Hamster *Mystromys albicaudatus* has been bred in the laboratory of the Medical Ecology Centre since 1941. It is of interest taxonomically in that it is the sole representative left in Africa of the subfamily Cricetinae (Davis 1962). It has been used in Medical Research on poliomyelitis, benign histoplasmosis, dental caries and certain other diseases (Davis 1963, Hall *et al.* 1967, Packer *et al.* 1970).

Meester (1960) has studied the early postnatal development of the Multimammate mouse *Praomys (Mastomys) natalensis* and the present paper is a sequel to that study.

MATERIALS AND METHODS

The breeding stocks of *Mystromys albicaudatus* were derived from an original nucleus started by Davis in 1941. The early postnatal development of thirty-three litters (six matings) was studied at the Transvaal Museum, Pretoria, by J. Meester and 18 litters (13 matings) were studied at the Medical Ecology Centre, Johannesburg, by A. F. Hallett. At the Transvaal Museum the animals were for the most part kept in cages 28 x 30 cm, with two adjoining nest boxes 14 x 14 cm. Cotton wool was used as nesting material. The cages at the Medical Ecology Centre measured 30 x 13 cm. The methods of observation and data recording were essentially those outlined by Meester (1960). The young of *Mystromys* become attached to the mammae soon after birth and remain firmly attached for about 30 days, only becoming detached occasionally.

The observations on litter size, sex ratio, intervals between litters, weight increase and development of certain features obtained from the present study have been published elsewhere (Meester and Hallett 1970). A brief summary of these observations is as follows: The mean size of litters was 2.9 and the relative number of ♂♂ : ♀♀ did not deviate significantly from a 50:50 ratio (53/47 per cent). Minimum age at first litter was 146 days and the minimum interval between litters was 36 days. The weight of the young at birth was 5.0–7.8 g, \bar{x} = 6.5 g in 39 young and the mean weight increase and the percentage increase is plotted graphically. Hair proliferation of *M. albicaudatus* is compared with various murid species and the times of development of certain other features are listed.

The purpose of the present paper is to record other features of the development of the young with some notes on the parent-young relationships.

DEVELOPMENT OF THE YOUNG

MORPHOLOGICAL

At birth the young were pink in colour with a translucent skin, and a grey tinge dorsally which was most marked behind the eyes. The body was hairless except for a few vibrissae 5–7 mm long and some very short bristles less than 1 mm long on the snout and chin. The feet were fleshy and the toes of both fore and hind feet were fused and had tiny claws. Eyes were closed and the ear pinnae were folded down over the external auditory openings.

Average weight at birth was 6,5 g and average weight of young of individual litters varied from 5,2 to 7,1 g. The head and body measured approximately 53 mm at birth and the tail about 14 mm.

Hair proliferation. The body remained hairless for the first five days after birth but the back became progressively darker and the vibrissae lengthened to about 8–9 mm. On day 6 short sparse hairs about 2 mm long and dull black in colour were present on the dorsal parts. They were most noticeable and dense on top of the head, neck and shoulders. Lower down on the snout, cheeks and sides of the body they were dark blackish grey, very short and not readily seen. The belly was pink and hairs were more sparse, about 1 mm in length. A patch of grey developed around the eyes by day 8, when the belly had a slight white tinge from the short hairs, through which the mammae were distinguishable. Hair appeared on the upper surface of the feet on day 9 but the outer sides of the legs, which were darkly pigmented, were hairless. A lighter grey tinge appeared on the head about the 9th to 10th day, particularly on the sides of the face. The back still appeared blackish grey while the belly had a strong white tinge anteriorly and a pink tinge in the genital region. The grey tinge on the head then spread to the shoulders and anterior back and the sides became lighter. By the 16th day the whole back had become light grey and only a small dark tinge remained on the posterior back. The belly also started to become slightly grey about day 13 but the pink tinge remained in the genital region until the 15th day. The belly then became uniformly pale grey.

Ears. The ear pinnae at birth were fleshy and folded over the external auditory opening. About the 3rd or 4th day the pinnae loosened. Not all pinnae of the same litter loosened simultaneously. In some individuals the pinnae loosened one at a time.

Toes. The feet were fleshy at birth and pink in colour. The toes of all feet were attached and loosened gradually. About the 4th–5th day the toes began to differentiate. The outer toes loosened first, and were about halfway loose when the others started loosening. The fore toes started slightly earlier than the hind toes and thus more fore toes than hind toes were loose during differentiation. As an example, in one litter it was seen on day 7 that toes 3 and 4 of the fore feet were attached and toes 2, 3 and 4 of the hind feet had not yet differentiated.

All toes were completely loose about the 9th–11th day.

Incisors. The incisors started erupting on the 3rd to 5th day but many erupted on the 6th or 7th day. The lower incisors usually erupted slightly before the upper. When first seen the lower incisors were about 1,5 mm long and the upper about 1 mm. After two weeks they were about 0,5 mm longer.

Eyes. A fairly wide range was found in the time of opening of the eyes, the average being between 16 and 20 days. Litters usually took 1–2 days before all eyes were opened and some took up to 4 days. In one individual one eye was found partly open and the other closed, and the next day both eyes were open. Sight was probably present when the eyes opened as one litter was seen eating solid food on day 20 when the eyes were first noticed to be open.

SENSORY ABILITIES

Although the ear pinnae were loose about the 3rd or 4th day response to sound only became apparent about the 13th to 15th day. The skin became sensitive to touch very early. It was observed that one young jerked vigorously on the 3rd day when a fly crawled over it. The sense of smell was probably present at birth because if young became detached even on the 1st day they would crawl around poking the nose in search of a nipple.

MOTOR ABILITIES AND BEHAVIOUR

Crawling and walking. At birth the young were able to crawl clumsily and lethargically when detached from the mother, and when held in the hand would crawl actively as if searching for a nipple. The crawling became more effective by the 5th to 6th day when they were able to crawl very actively when held in the hand, and when they became detached from the nipple they were able to crawl under the mother. Leg waving while attached to the nipple was observed from birth and this developed into a positive pushing action on the ground when they were dragged by the female. After about the 20th day the young would be detached quite easily when the female was disturbed and they could then walk relatively fast but were still somewhat wobbly. They were able to run from about the 24th day.

Standing up and climbing. Standing on the hind legs was not observed until very late. They were able to sit on the hind legs to eat solid food from about the 21st day, but standing on the hind legs was not seen until the 37th day although it may have occurred earlier. *Mystromys albicaudatus* were much less active than *P. (M.) natalensis* (Meester 1960) and they were not seen to climb actively like the latter species although one animal was seen climbing on the side of the cage on day 29.

Jerking and hopping. This activity is not a feature of *Mystromys albicaudatus* as in *P. (M.) natalensis* (Meester 1960). When the cage is opened the adults usually stand on the hind legs and investigate the disturbance by sniffing. Sometimes they may show aggressive behaviour, but this is also not a prominent feature when the animals do not have litters.

Self-grooming. Scratching was the most prominent feature of self-grooming although face washing and licking were also seen.

Scratching. While still attached to the mother, the young responded to touch by scratching the belly, but scratching for grooming was only seen when they had become detached, from about day 21. The scratching was done with the hind foot on the belly and head. The scratching in response to touch while attached to the mother was rather inefficient but became more effective when they were detached.

Face washing. This was not seen until the 21st day when the young started eating solid food. It was done with the fore paws as in *P. (M.) natalensis* (Meester 1960).

Licking. This consisted mainly of licking the fore paws, immediately followed by face

washing. The hind feet were also occasionally licked. The fur of the abdomen was licked and then scratched immediately afterwards.

Contactual behaviour. Similar contactual behaviour to that seen in very young *P. (M.) natalensis* was observed. When the young occasionally became detached from the mother soon after birth there was considerable squealing, waving of the legs, and searching for a nipple. When completely separated from the mother they would crawl around searching. This happened until about day 21 when the young started eating solid food. At that stage the young would sit in close proximity to the parents and often crawl under them. (Both parents take care of the young.) They would then start making short exploratory trips around the cage but when disturbed would immediately run back and huddle under the parents. In the adult, the contactual urge does not seem to be as strongly developed as in *P. (M.) natalensis*, as they do not sit huddled together to the same extent.

Feeding. The young remained attached to the mother from the time of birth for about three weeks, only occasionally becoming detached. Similar behaviour has been observed in other species, e.g. *Peromyscus crinitus pergracilis* (Egoscue 1964), *Aethomys namaquensis*, *Tatera brantsii* and *Thallomys paeuducus* (Meester and Hallett 1970). The attachment was so firm that the young would be dragged around by the female wherever she went. Even before the incisors had erupted the young were rather difficult to dislodge from the nipples. After the third week the periods of detachment would get longer and during that time they would begin to show interest in solid food. They would still, however, suckle for short periods up to about the 38th day. After detachment on about the 21st day they would sit close to the parents, pick up small pieces of food with the fore paws, and nibble pieces from these. They were very partial to meat but also ate carrots and mouse biscuits. On the 26th day a piece of meat was put in a cage near a litter attached to the mother. They all immediately detached and started eating the meat. One young was seen drinking water on the 22nd day and then started suckling immediately afterwards. After they had begun showing interest in solid food the young could be very easily dislodged from the nipples and often became detached when the mother was disturbed. Soon after the eyes opened the young began eating solid food, and in one case the eyes were noticed to be open only on the day they were first seen eating solid food, at which stage the attachment to the nipples was also loose.

Investigative behaviour. When the eyes had opened and the young were not attached to the nipples continuously, they would start making short trips in the area surrounding the nest. At first they would dart straight back to the parents when disturbed, but after about 5 weeks they would investigate disturbances by sniffing. The first investigative behaviour was probably in search of solid food. They showed great interest in pieces of meat by the 24th day and would also nibble at bits of straw and even faeces lying around. At that stage they would sit away from the nest and parents eating quite unperturbed, but would immediately run for cover when disturbed. When they could stand on their hind legs they seemed to become bolder in investigating disturbances and by the 37th day some did not run away when disturbed. Their activities were always much more cautious than those of *P. (M.) natalensis*, and movements much slower. They did not climb around and over the cage as did *P. (M.) natalensis* but confined themselves to the ground surface and would only investigate those areas which could be reached by standing on their hind legs.

Agonistic behaviour. This term is used in the same sense as in Williams and Scott (1953) and Meester (1960) and includes aggressive behaviour and response to pain and disturbance. At birth the young squeaked intermittently, while attached to the nipple, when they were disturbed. If picked up in the hand they would continue to squeak and crawl between the fingers as if searching for a nipple. The squeaking diminished about the 10th day and when held in the hand at that stage they would crawl around more actively in attempts to escape. After three weeks, they would sit in close proximity to the parents and would run from any disturbance and cuddle under the parents. Fighting was very rarely seen in the young. In a single litter one young took up a defence posture on the 25th day when the adult male sniffed at it, and on the 29th day this same young was seen fighting with a litter mate. They embraced and then nipped each other on the head.

Fighting was also very rarely seen in adults and the threat posture was not adopted when they were disturbed as in *P. (M.) natalensis*. When handled, the adults did occasionally bite without warning but generally they were very tame and docile to handle.

Sibling care. Care of the young by young of previous litters, as observed in *P. (M.) natalensis* (Meester 1960), was not seen in *M. albicaudatus*.

INJURIES AND MORTALITY

Mortality of one or more young was found in 11 litters. In six cases death occurred on or before the 7th day. One was found dead with a leg caught in twisted cotton wool and was bloated with blood, but the cause of death of the others was not apparent. In the other 5 litters deaths occurred between the 17th–27th day.

Death of a stunted young in two litters, each containing three young, occurred on days 17 and 19. Two days after this a second young in each litter died (possibly killed by the parents).

Two dead young were found partially eaten, and one of these was seen being eaten by the parents.

PARENT-YOUNG RELATIONSHIPS

FEEDING

Immediately after birth the young became firmly attached to the mother's nipples. In only one litter were the young found loose on the day of birth and these had a slight amount of blood on the bodies, indicating very recent birth. After attachment of the young the female was able to walk around quite normally dragging the young under her. Occasionally they did become detached during the first few days after birth, and they would then squeak and poke their noses around in the air searching for the mammae.

From about the 19th day the periods of detachment became more frequent and the young were dislodged from the nipples more easily when disturbed. On the 22nd day one young was seen to drink water and then attach to the female. After about the 25th day the periods of detachment were longer than the periods of suckling, and young were rarely attached after the 32nd to 35th day. During these later periods of detachment the young

sat huddled close to the parents, and at the slightest disturbance, buried themselves under the parents.

PROTECTION

As previously mentioned *Mystromys albicaudatus* is a rather docile rodent and protection of the young was mainly by taking evasive action, the female dragging the attached young under her and sheltering them. Aggression was however shown by both parents when provoked.

Aggression. Both parents were normally more aggressive soon after the young were born and they gradually became more docile until the young were weaned. The male was often more aggressive than the female and would investigate any disturbances. When provoked with a metal probe, the parents would stand on their hind legs and bite the end of the probe.

About two weeks after the birth of a litter, the parents became less interested in disturbances and their defence became much less vicious. By the end of the third week they would take up a defensive position, and would also hide under the nesting material. If provoked further with a probe they would only bite tentatively.

Sheltering the young. During the first few days after the birth of a litter the parents remained huddled over the young in the nest. Both male and female would sit close together sheltering the young. On day 8 the young of one litter became detached and both parents sat hunched over them. When disturbed with a probe the female moved away but the male attacked the probe viciously and remained next to the litter. The female then returned, sat over the young and also attacked the probe.

At about three weeks when the young were often seen detached, they would sit huddled next to the parents. When disturbed they would burrow under the parents and into the nesting material. This behaviour persisted until observation ceased about the 38th day, by which time they had started exploring their environment. As soon as they were disturbed they would immediately run back to the parents and huddle together.

Carrying young away. The young were firmly attached to the mammae and were dragged under the mother when she moved about the cage. Carrying the young in the mouth, as observed in other rodents (Huestis 1933, Horner 1947, Meester 1960, Wrangham 1969), was seen only once. On this occasion the young were only just born as there was still some blood on their bodies. They were removed from the cage for examination, and upon their return were licked by both parents. The male then picked one up and carried it away, then put it down and picked it up again. This was repeated a few times. Eventually it was taken out of the mouth of the male by the female, and was then carried about again by the female. This action was later repeated with another young.

The following day the young were attached to the female and the behaviour of carrying the young about was not seen again in this or any other litter, even when the young became detached from the mammae.

GROOMING

Only the female was seen grooming the young. This was done by licking. It was observed from the day of birth until the young were about 4 weeks old, and was noticed particularly after the litter had been disturbed. If a suckling young was handled or removed from the

cage, vigorous licking followed upon the return of the young to the mother. When the young started exploratory behaviour and were disturbed they would run back to the mother and huddle under her. Vigorous licking of the young would then follow.

DISCUSSION

The most striking feature of the postnatal development of *Mystromys albicaudatus* is the clinging of the young on to the mother's nipples until almost fully weaned. This attachment appeared to be more firm after the eruption of the incisors about the 3rd to 5th day. Davis (1963) attributes the high survival ratio (over 80%) of the young to this characteristic and the consequent protection offered.

The 4 species studied in which the young do remain attached to the nipples during early postnatal development, i.e. *M. albicaudatus*, *T. brantsii*, *Thallomys paedulus* and *Aethomys namaquensis*, produce small litters (Meester and Hallett 1970). This has a definite survival value as the size of the litters should not be greater than the total number of nipples. *M. albicaudatus* has 4 mammae but exceptionally 5 young are born. These are reared by the mother dislodging one occasionally to suckle the odd young (Joubert 1967).

The eruption of the incisors occurs early in the species remaining attached to the nipples compared with *P. (M.) natalensis* which does not remain attached (Meester and Hallett 1970). This appears to assist the young in maintaining a firm hold on the nipples and therefore also has a survival value.

The species which remain attached to the nipples are weaned later than *P. (M.) natalensis* (Meester and Hallett 1970). This greater dependence on the parents with the resultant protection offered to the young compensates for the higher reproduction rate and early weaning of those species which do not remain attached.

The critical periods for survival observed by Williams and Scott (1953) and Meester (1960) are therefore of less importance in the South African Hamster. A possible critical period could be when the eyes open, about day 16. Young were noticed to be loose from the nipples for the first time at approximately that stage. They could also walk quite effectively and also began eating solid food. However the young maintained a very close relationship with the mother until very much later, thus reducing the danger of this critical period.

SUMMARY

The South African Hamster *Mystromys albicaudatus* litters studied were naked at birth, but developed hair on the dorsal parts after about 5 days. Hair then developed rapidly on other parts of the body.

The development of the ears, toes, incisors and eyes were studied and response to sound became apparent after about two weeks.

Although they could crawl clumsily at birth this only became effective after 5 days and gradually developed into walking and running.

Self-grooming typical of other rodents, in the form of scratching, face washing and licking, was observed.

The young remained attached to the mother's nipples for about three weeks after birth and after that the periods of detachment gradually became longer until they ceased to suckle at about the 38th day.

Investigative behaviour became evident soon after the eyes opened. At first it was limited to the immediate vicinity of the nest but gradually more extensive exploration of the environment developed.

Response to disturbance by squeaking and squirming was evident from birth and developed into escape attempts when they could crawl.

Protection of the young by the parents took the form of aggressive behaviour to intruders and sheltering the young by huddling over them.

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REFERENCES

- DAVIS, D. H. S. 1962. Distribution patterns of southern African Muridae, with notes on some of their fossil antecedents. *Ann. Cape prov. Mus.* 2: 56-76.
- DAVIS, D. H. S. 1963. Wild rodents as laboratory animals and their contribution to medical research in South Africa. *S. Afr. J. med. Sci.* 28: 53-69.
- EGOSCUE, H. J. 1964. Ecological notes and laboratory life history of the canyon mouse. *J. Mammal.* 45: 387-396.
- HALL, A. III, PERSING, R. L., WHITE, D. C. and RICKETTS, R. T. JR. 1967. *Mystromys albicaudatus* (The African white-tailed rat) as a laboratory species. *Lab. Anim. Care* 17: 180-188.
- HORNER, B. E. 1947. Paternal care of young mice of the genus *Peromyscus*. *J. Mammal.* 28: 31-36.
- HUESTIS, R. R. 1933. Maternal behaviour in the deer mouse. *J. Mammal.* 14: 47-49.
- JOUBERT, C. J. 1967. Total nutritive requirements for small laboratory rodents (including rodents indigenous to South Africa). In *Husbandry of Laboratory Animals*. Conalty, M.L. (ed.) London: Academic Press.
- MEESTER, J. 1960. Early post-natal development of multi-mammate mice *Rattus (Mastomys) natalensis* (A. Smith). *Annals Trans. Mus.* 24: 35-52.
- MEESTER, J. and HALLETT, A. F. 1970. Notes on early post-natal development in certain southern African Muridae and Cricetidae. *J. Mammal.* 51: 703-711.
- PACKER, J. T., KRANER, K. L., ROSE, S. D., STUHLMAN, R. A. and NELSON, L. R. 1970. Diabetes Mellitus in *Mystromys albicaudatus*. *Archs. Path.* 89: 410-415.
- WILLIAMS, E. and SCOTT, J. P. 1953. The development of social behaviour patterns in the mouse, in relation to natural periods. *Behaviour* 6: 35-64.
- WRANGHAM, R. W. 1969. Captivity behaviour and post-natal development of the Cape Pouched rat *Saccostomus campestris* Peters. *The Puku* 5: 207-210.