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THE ONDERSTEPOORT SMALL ANIMAL COLONY.

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At one time the small laboratory animals used at Onderstepoort were bought from private individuals who bred them in a rather haphazard way so that the supply was very unreliable. The chief objection, however, was that infections of various types were introduced and later, when large numbers of animals were required, it was impossible to rely on private breeders.

The small animal colony at Onderstepoort has shown considerable expansion during recent years. The annual issues of small animals to the various sections indicate the approximate breeding stock that has to be maintained: —

TABLE 1.

Annual Issues of Small Animals.

Year.	Mice.	Guinea-pigs.	Rabbits.	Rats.	Ferrets.
1938	42,400	5,672	516	769	15
1939	60,500	3,803	333	342	17
1940	80,000	3,964	512	774	33
1941	79,000	5,559	508	1,300	2
1942	86,000	4,209	308	1,895	17
1943	77,000	3,146	294	1,044	41
1944	143,760	5,049	209	627	121
1945	133,645	6,805	264	562	48
1946	129,870	7,265	498	1,212	44
1947	94,126	6,981	569	819	229
1948	108,307	6,536	210	485	473
1949	129,190	5,982	351	597	224
1950	126,320	5,432	360	430	329
1951	145,462	3,783	601	312	186

The chief disease investigations for which these animals have been used include the following: Horsesickness, mainly vaccine preparation, brucellosis, tuberculosis, trypanosomiases, anthrax, blackquarter, botulism, malaria, rabies, welchii infections, salmonella infection antiserum and virus work, as well as endocrinological and nutritional work.

Although no specialized genetical studies are conducted, meticulous care and attention are paid to selective breeding in the colony, in order to maintain a high standard of vigour and litter size. Efforts are made to reduce infections to a

* Since retired.

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minimum. The necessity for supplying research workers with uniform types of animals is stressed by Hutt (1945). For these reasons strict and continuous selection is necessary.

Originally the housing and management were based on the systems that are generally in use in Europe and America. Although the closed house is eminently suitable to the climatic conditions in Europe, it is not for tropical and sub-tropical countries, where floor space is not limited and central heating unnecessary. The more important difficulties to be contended with in hot climates are inadequate ventilation, control of ecto-parasites and prevention of food fermentations and rancidity, which are liable to cause production of toxic substances or destruction of essential vitamins. For these reasons wooden tiers or cages are undesirable. All equipment should be constructed of durable metal that can stand up to autoclaving at least once a fortnight. Buildings should be of brick and be so constructed that repellent sprays may be easily applied. Hygiene, feeding and management are of the greatest importance.

Housing, Hygiene and Management, Breeding and Handling, Feeding and Nutritional Requirements.

(1) *Albino Mice* (Mus Musculus).

Mice kept for breeding purposes are the only type of small animal to be housed. They are kept in large, well-constructed, airy, brick buildings with iron roofs as shown in figure 1.

Figure 1.

Mouse Breeding House at Onderstepoort.

Large double doors and windows are clearly shown. In addition each room is fitted with exhaust fans capable of giving four air turnovers per hour if required. It is necessary to maintain a room temperature of 70° to 80° F.

The breeding unit shown in Figure 1 consists of four rooms, 25 feet by 22 feet, with a central room measuring 22 feet by 14 feet which is used as a kitchen and sterilizing room. Each of the large breeding rooms houses four rows of all metal tiers (Figure 2).

FIGURE 2.

All-metal Tiers in Mouse Room.

These stands are 4 feet 7 inches high and three sections placed end to end measure 17 feet 3 inches. This gives five shelves, 2 feet 4 inches wide and capable of accommodating 1,200 galvanized, 24 gauge flat iron mouse cages measuring 12 inches by 6 inches by 6 inches each.

The inside height of the walls is 10 feet. It will be noted that the tiers are just high enough from the floor to allow easy handling of the cages and that sufficient space is allowed for sweeping and cleaning. In order to have a minimum of crevices all electric and other tubing is chased into the walls. A hand wash-basin of the normal laboratory type is set in a corner of one of the rooms.

The sterilizing room is equipped with two autoclaves, a central cement-slabbed table and the necessary washup sink with draining slabs at the sides. The only direct communication between the sterilizing room and the room on each side of it is by means of a service window which may be closed by a sliding cover as shown in Figure 2.

Routine sterilization is so arranged that all cages are passed through the auto-clave every other week. Unsterilized cages are handled on the open air cement floor where there is a sink for washing them before autoclaving, as shown in

Figure 1. When sterilized they are passed directly through the service window for use. All cages are cleaned, not sterilized, and provided with sound veld hay twice per week. Cottonwool used as bedding proved to be less satisfactory than hay. Stands are dusted and rooms swept daily. Walls and floors are washed down with disinfectant once a week.

The Breeding and Handling of Small Animals.

Where large numbers of mice are required, it is advisable to evolve some breeding system whereby a good check can be kept on breeding performance with a minimum amount of effort. This is best achieved by mating mice for the whole of their useful breeding period which is 12 months. Although sexual maturity is attained at the age of six weeks, females are not mated until they are two and a half to three months old. In order to obviate the possibility of mistakes all males intended for breeding are marked with a water saturated solution of picric-acid at weaning. A young male of a month old is put into the cage to which two females are introduced. Unless this procedure is followed, the results are often unsatisfactory as the animals may attack one another.

The length of the gestation period is from 19 to 21 days. An average litter size of six is regarded as satisfactory although litters of 15 have been obtained. Young get their hair at six days and eyes open at 14 days of age. Care should be exercised during major cleaning operations not to disturb the litter unduly, as excited animals may attack their offspring.

Regularity in the feeding and management is always an important factor. At four weeks of age mice are weaned and future breeders are selected and sexed. The available stock go to separate houses and are used in experimental work after six weeks of age. The original male and two females are left in the cage. During the 12 months that a female is kept for breeding, she should produce about 50 young.

Every morning when mice cages are cleaned, they are examined for new litters. All cages in which births have occurred during the week are tabbed with a coloured plastic or paper disc secured by means of a wire hook. The following week a differently coloured paper disc is used. In this way there are five different colours. When the first colour reaches weaning age at four weeks, the fifth colour is used on the remaining cages. All cages are now grouped in their different colour groups so that the number of births in each week can easily be recorded. Such a procedure enables the fecundity for the colour groups to be obtained at a glance. However, of greater importance is the ease with which non-breeders may be eliminated because their cages would not be tagged. If too large a number of cages miss the coloured tag during any five weeks cycle, a thorough examination as to the possible cause can be made immediately.

Mice will normally breed throughout the year if the temperature is controlled. Normally, mating takes place during darkness.

The oestrous cycle in the mouse is from four to six days, ovulation occurring two to three hours after the onset of oestrum. Postpartum ovulation may be expected at 14 to 27 hours after parturition. It is possible, therefore, for a litter to arrive before the previous one has been weaned. Such cases actually do occur. The vaginal plug which lasts from a few hours to a few days is an indication that mating has taken place.

Feeding and Nutritional Requirements.

The feeding and watering of mice is a daily routine and is done when stands are cleaned every morning. As may be observed in Figure 3, the perforated lid of the cage has a hole large enough to fit the glass tube which is attached to the 100 c.c. water bottle. The balanced ration is compressed into cubes which are put into a tin cup containing a wire bottom. This cup fits into the lid as shown in Figure 3. In this way mice are unable to foul their food.

FIGURE 3.

Carruthers (1941) drew attention to the inadequacy of synthetic diets for mice. It is advisable, therefore, to compound the balanced ration from as variable a number of ingredients as possible.

Grain and protein-rich feeds used in small animal rations should not be rancid or infested with weevils. Storage should, therefore, be provided in a vermin proof, cool and well-ventilated room. If necessary, feeds should be treated, preferably by fumigation, with such substances as methyl bromide, carbon tetrachloride or hydrocyanic acid gas and well ventilated thereafter.

The mouse biscuit or comproid used at present is compounded from various ingredients as follows:—

Yellow maize meal, 1,000 lb.; peanut cake meal, 150 lb.; linseed cake meal, 50 lb.; carcase meal, 200 lb.; white fish meal, 150 lb.; Sussex oats, 300 lb.; wheaten bran, 150 lb.; lucerne meal, 20 lb.; food yeast, 20 lb.; molasses, 150 lb.; salt, 10 lb.; lime, 10 lb. and 100 grams of synthetic vitamin A powder (80,000 I.U./gr.).

The composition of the mouse comproid is: 19·16 per cent. protein, 5·45 per cent. fat, 3·19 per cent. fibre, 6·81 per cent. ash, 10·70 per cent. moisture, 54·70 per cent. N-F-E. The ash containes 1·47 per cent. Ca and 0·93 per cent. P.

The vitamin A content of the fresh material is approximately 1,446 I.U. per lb., vitamin E about 6·69 mgm. per lb., and the B-complex per pound may be given as: Thiamin 2·1 mgm., riboflavin 1·35 mgm., nicotinic acid 21·75 mgm., pantothenic acid 6·9 mgm., and choline chloride 388 mgm. per lb.

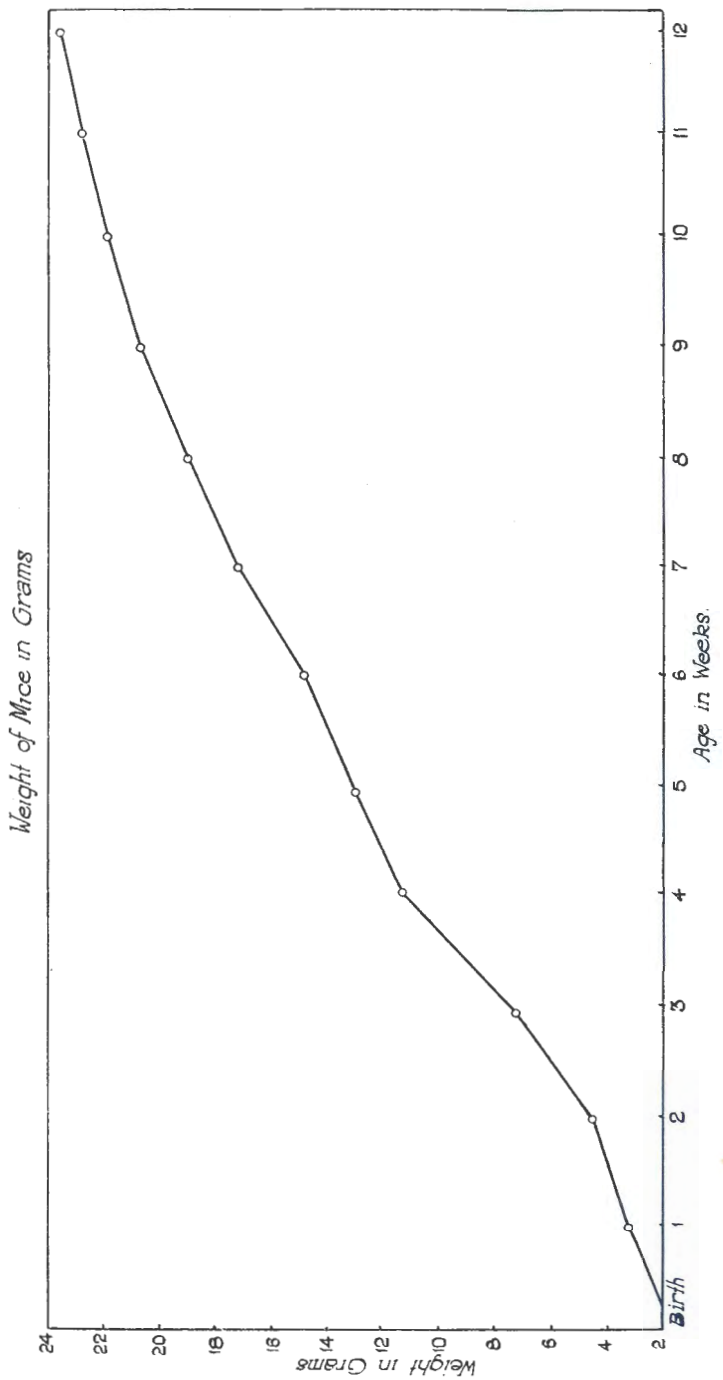

Weight of Mice in Grams
Weight in Grams
24
22
20
18
16
14
12
10
8
6
4
2
Birth
1
2
3
4
5
6
7
8
9
10
11
12
Age in Weeks.

FIGURE 4.

In order to ensure an adequate further supply of vitamins, a little greens, chiefly in the form of cut lucerne is fed twice weekly. However, in the absence of additional greens, the mouse comproid alone seems to give results.

It is emphasized that the feeding of milk has been entirely dispensed with Not only is this labour-saving, but better results appear to be obtained without it, probably due to more satisfactory hygienic conditions.

It has been found that 1,000 mice consume approximately 13¼ lb. of mouse comproid per day, or 6 grams per mouse daily.

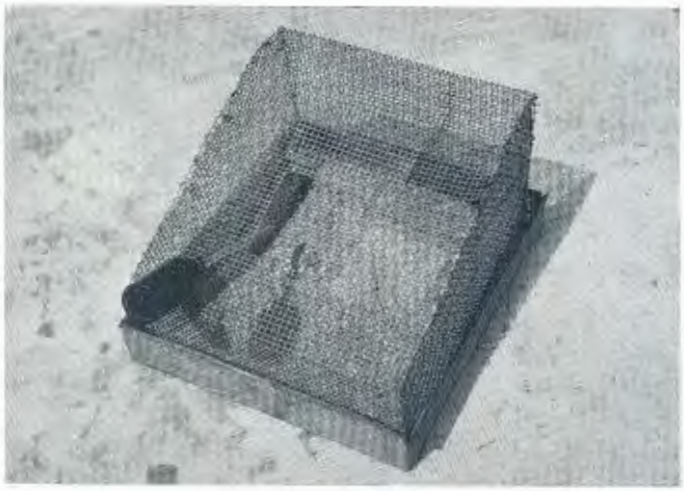
Although the various nutrient requirements of mice will not be discussed in detail, experience has shown that the breeding of mice in the Union is less satisfactory when the comproid contains 17 per cent. total protein than when a 20 per cent. protein ration is fed.

At birth the young weigh approximately one gram. Mice usually make excellent mothers and it is not uncommon to see a female taking weaklings for a separate feed, whether such small mice are her own or those of her cage mate.

Provided the nutrition and management of the mouse is correct the average gain in weight should approximate that shown in Figure 4.

FIGURE 5.

Mating Cage for Rats.



(2) *Albino Rats* (Rattus norvegicus).

According to the data given in Table 1, it will be observed that the rat has played a minor role in the Onderstepoort investigations. As there is no necessity for high pressure breeding, overcrowding is less likely, with the result that comparatively few difficulties have been experienced in the rat colony. Available stock are frequently housed and managed in the cages which will be described in detail for guinea-pigs. Breeding is, however, more successful when the type of all-metal cage illustrated in Figure 5, is used.

Rat cages are housed in well ventilated rooms fitted with thermostatically controlled heaters. The general hygiene and management are then similar to that for mice.

The dimensions of a suitable mating cage for rats may be given as: 1 foot 2 inches by 1 foot by 4½ inches. The height is 5 inches at the front and 9 inches at the back. The wire lid opening is 6 inches by 6 inches.

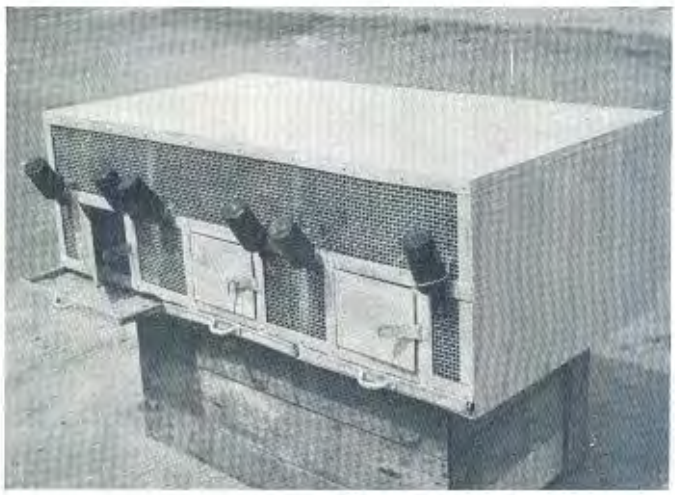
The rats used originally came from the Wistar Institute albino rat colony. With slight modifications the breeding procedure is as described by Edmond J. Farris (1949).

Usually four females three to four months old are put to one male in the special wire mating cage shown in Figure 5. As soon as the females are obviously pregnant, they are transferred to individual compartments of the type of cage shown in Figure 6. The dimensions of the cage may be given as: 2 feet by 3 feet 9 inches by 1 foot 3 inches. The three compartments are 1 foot 3 inches by 1 foot 3 inches by 2 feet each and the doors 6¾ inches by 5¼ inches. The cage has a removable galvanized flat iron tray for cleaning purposes.

The oestrous cycle in the rat is about three to five days. As soon as the females are served they are removed to individual breeding cages which should be darker, as shown in Figure 6.

FIGURE 6.

Breeding Cage for Rats.



Mating generally takes place during the night or early morning and may be detected by the vaginal plug which may be seen from six hours to ten days, or an average of two days, afterwards.

The gestation period is about 21 to 23 days, and the average litter size is 7. It is not advisable to disturb the mother rat during the first week as she may destroy the young. Rats are weaned and sexed at a month old. Full details on the growth and breeding of the albino rat with special reference to the local environment is given by Murray (1941).

The handling of rats is the same as for mice. Their useful life-span is about two years.

The nutritive requirements of rats have been more intensively studied than those of any of the other small laboratory animals, because rats have been so extensively used in basic nutritional studies. [Kellerman (1934), Thomson (1936), Morris *et al* (1933), Morris (1942), and Orr (1936).]

The concentrate ration for the rat may be the same as described for the mouse. At Onderstepoort it is found that about 10 per cent. of the mouse comproids become crushed to meal in transit and this meal is then used in the feeding of rats. Although the 100 c.c. bottle is used for the water supply (Figure 6), the rats are fed their concentrate ration in meal form, given in earthernware pots. If these pots are not too large and the ration fed dry, the danger of fouling the feed is reduced to a minimum. Rats are also given a little chopped greens twice a week, although this is not essential. Detailed requirements of rats are given by Farris (1949).

GUINEA-PIGS (*Cavia porcellus*), RABBITS (*Lepus cuniculus*), AND FERRETS (*Mustela putorius var. furo*).

These animals are all kept in concrete cages which are fixtures on a concrete floored paddock. A dense 7 feet privet hedge is grown around the paddock as a windbreak and poplar trees (*Populus Wislezenii*) are spaced at suitable distances inside the paddock to provide shade during the warm summer months. A general view of the colony hutches and trees is shown in Figure 7.

Each cage has a strongly constructed wire-enclosed run securely attached to it. These cages may be of any convenient length. A minimum amount of wood should be used.

Every morning all old bedding is removed and the troughs cleaned. Runs are then thoroughly hosed and swept, after which they are freshly bedded down with veldhay. Once a month all old bedding in the huts is burnt as a measure for the destruction of fleas, bugs, ticks, etc.

For breeding purposes guinea-pigs are generally used at about the age of three months or when they weigh approximately 600 grams. They are not unduly sensitive to weather changes and will breed throughout the year in our outdoor cages. Guinea-pigs do well if kept in small groups of one male to ten females. The oestrous cycle is 16 days and ovulation takes place about 10 hours after the onset of oestrum. The cycle is not disturbed by lactation.

The guinea-pig has a long gestation period averaging 68 days. It is not a prolific breeder and a litter usually contains three or four young only. Under group-breeding conditions a female raises an average of nine young per annum.

It is advisable to wean guinea-pigs when a month old. At this time the mammae of the does should be examined for any abnormality as this is likely to interfere with the rearing of their young. Young guinea-pigs about six weeks old weigh 200 to 300 grams and should then be ready for routine issues. The useful breeding life of a female is about two years.

When weaning and culling take place certain cages are cleared for the new stock of breeders. However, it not infrequently happens that females show alopecia after the gestation and lactation period and should be rested for a few weeks before again being mated.

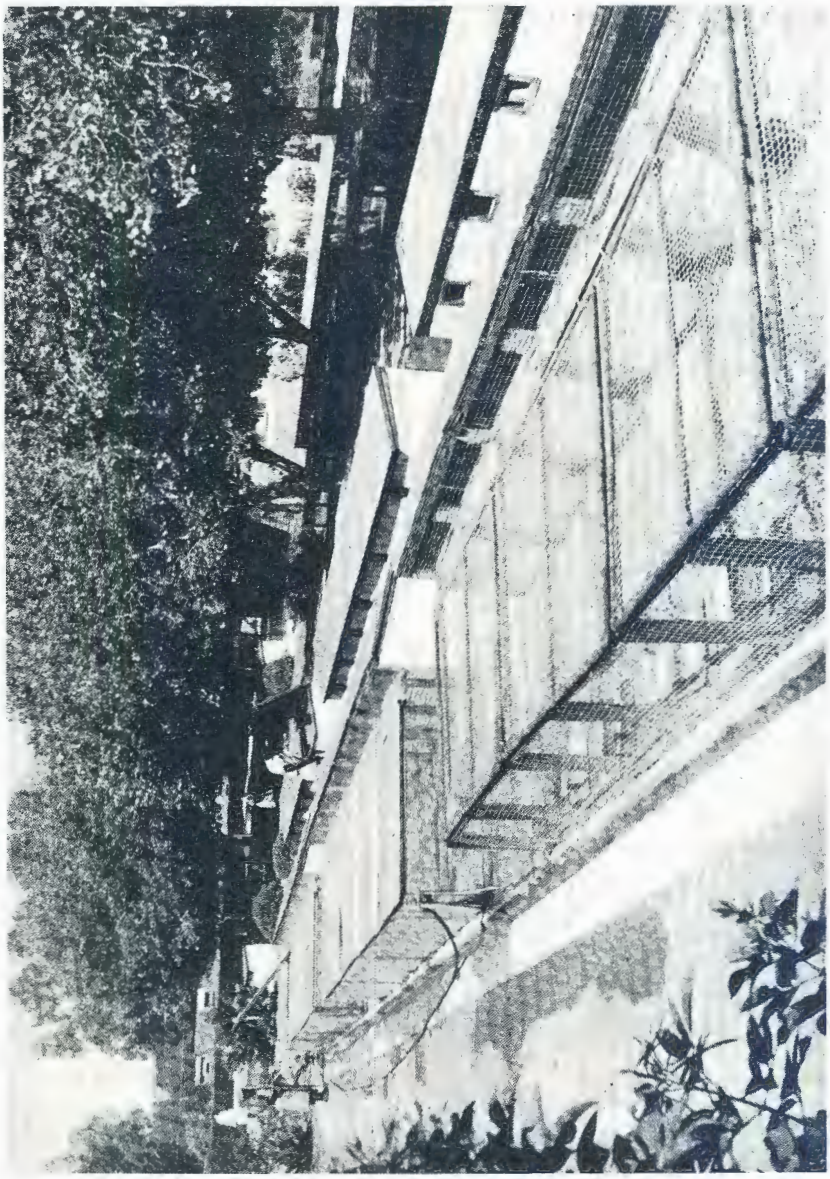


FIGURE 7.

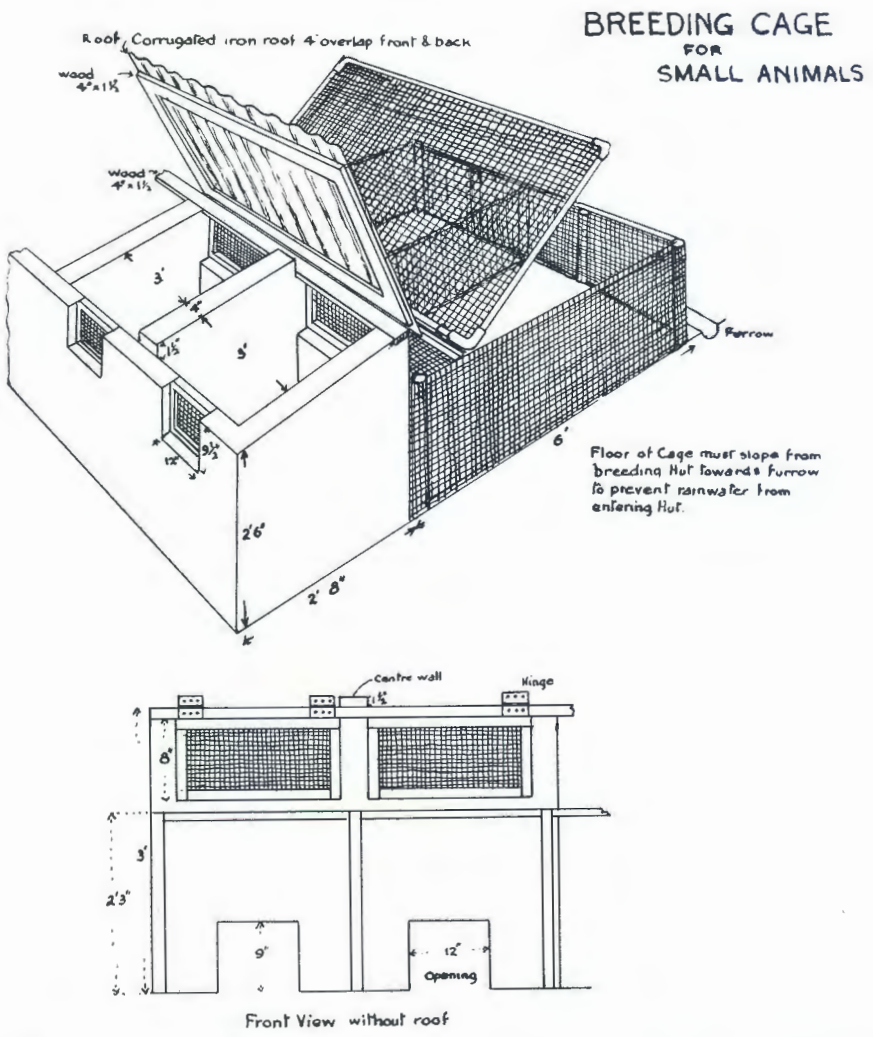
Colony Hutches.

(3) *Guineapigs* (Cavia porcellus).

Full details in regard to the dimensions and construction of the breeding cages are given in Figure 8.

Young guinea-pigs weigh 90 grams at birth, have their eyes open and are born with a good hair coat. They make fairly rapid weight gains and often reach 280 grams when weaned at a month old.

FIGURE 8.



The method of feeding and watering guinea-pigs is illustrated in Figure 9.

A system of open tin pans is in use. These pans are cleaned thoroughly every morning when the pens are hosed down. One pan is filled with clean water and the grain concentrate is put into the other pan.

The breeding ration consists of: Yellow maize meal, 40 per cent.; crushed oats, 10 per cent.; wheaten meal, 25 per cent.; linseed oil cake meal, 10 per cent.; meat meal, 5·55 per cent.; lucerne meal, 6·0 per cent.; bone-meal, 2·0 per cent.; salt (NaCl), 0·5 per cent. and calcium carbonate 1·0 per cent.

FIGURE 9.

Guinea-pig Hutch.

In addition guinea-pigs are given a liberal supply of greenfeed, usually in the form of green lucerne. They relish lucerne hay, too, and a small supply is usually given as shown in Figure 9. However, for the guinea-pig lucerne hay is not a substitute for greenfeed. This may be attributed chiefly to the vitamin A and C requirements of this animal.

Myburgh (1951) found that guinea-pigs fed a dry ration became stunted and contracted paralysis of the hindquarters within two weeks. The supplementation of 3,500 I.U. vitamin A and 2 mgm. vitamin C per day, affected a complete cure, with normal appetite and growth, as well as enabling the storage of 1,500 I.U. per gram of liver in 2½ weeks after supplements were started.

When guinea-pigs received 50 gm. of greens daily, no clinical symptoms of avitaminosis were evident and after eight weeks the liver storage amounted to 80 I.U. per gram.

The group of guinea-pigs that received good quality lucerne hay and no greens for eight weeks appeared to be normal and did as well as the group that received greens. However, the vitamin A content of the livers averaged 2-5 I.U. per gram, which indicated that they were actually on the borderline of vitamin A deficiency. In all cases 2 mgm. vitamin C was supplemented to each guinea-pig daily. Therefore, provided vitamin C is given, it would be possible to feed good quality lucerne hay for short periods when greens may be unobtainable.

While Woolley (1942) drew attention to new dietary essentials required by guinea-pigs, their rations may be comparatively simple as shown by Kuikin (1944).

The mature guinea-pig consumes approximately 40 grams of grain and 80 grams of greens per day. In actual fact the rations may vary considerably. The changing of the grain ration occasionally is advantageous. These animals are

fond of munching grains and for this reason a small percentage of whole grain such as oats or barley may be incorporated. *Fresh water is necessary at all times as a mature guinea-pig consumes about* 150 *c.c. per day.*

(4) *Rabbits* (*Lepus cuniculus*).

The rabbit has a peculiarity in that the doe may at times be in continuous oestrum for as much as 60 days. The erroneous impression has, therefore, established itself that the female rabbit is always in oestrum. This is not so as there are times when it will refuse the buck. This is more often the case during late autumn and early winter. There are many theories about the oestrus in the rabbit (Hammond, 1925).

Although a doe may remain in oestrum for 60 days, there is a peak period when she becomes obviously restless and constantly thumps the floor with her hind legs. If examined the vulva will be found to be swollen.

At this stage the doe should be taken to the buck. After two falls the doe may be considered to be properly served. Repeated matings after this will not increase the number of ova shed so the doe should be returned to her own cage.

It is suggested (Smelser *et al*, 1934), that the actual oestrous cycle may have an average duration of 15 days, but that dioestrus is so short as to escape notice. Usually ovulation takes place 10 hours after copulation. About three weeks after service pregnancy may be determined in the doe by palpation. The gestation period is 30 to 33 days, with an average of 32 days. Young are born hairless and blind. The haircoat is fully developed at six days and the eyes open at eleven days.

The veld hay bedding in the nesting compartment should be changed a few days before the litter is due.

The young may be inspected a few hours after they are born provided the doe is accustomed to handling. At the same time it is advisable to limit the litter to six for ordinary does or possibly eight in the case of good milkers. This is done by destroying subnormal young or runts.

For the first three weeks of their lives young rabbits are entirely dependent on their mothers. Between the 3rd and 4th week they leave the nest and start nibbling at feed in the exercising pen. Rabbits should not be weaned until they are six to eight weeks old. Although they attain sexual maturity at four months, they should not be mated until seven months old.

If properly cared for and not allowed to rear too many litters, say not more than four a year, does will remain active breeders for four years and bucks even longer. At present there are bucks in the colony that have been used for five years.

At birth the rabbit weighs as much as 60 grams. Birth-weight depends on the litter size rather than length of gestation.

The aim in rabbit breeding should be not only to increase weight, but to establish a prolific strain. For this reason it is advisable to keep records of the progeny. The system practised at Onderstepoort is to examine litters soon after birth and to mark good ones with picric acid. Such litters may even be sexed at this age and are then weighed daily. At three weeks of age those that made unsatisfactory gains are culled and the rest given a strain number tattooed in the left ear.

At eight weeks, if still satisfactory, they are given individual numbers, tattooed in the right ear. These numbers are then entered in the stock book.

FIGURE 10.

Lifting a Rabbit.

FIGURE 11.

Holding a Rabbit.

In order to ensure an adequate intake of milk, it is advisable to limit the litter size of breeding stock to about six. Normal weight gain of the individual rabbit during the first three weeks of life is an important factor in the later development of these animals.

The proper way to lift and hold a rabbit is clearly illustrated in Figures 10 and 11.

Actually the rabbits are fed and housed in a similar way to the guinea-pigs. The feed should consist of greens, roughages and concentrates.

The most suitable greenfeed is lucerne and barley. Greens such as lettuce, cabbage and carrots are in themselves very satisfactory but unfortunately the supply is erratic and sudden changes in diet often result in diarrhoea.

The rabbit is a selective feeder and likes a variation within the grain itself. For this reason a small percentage of whole grain may be included.

An example of a suitable concentrate is the following:—

Yellow maize ... ... 30 per cent. Crushed maize ... ... 10 per cent.	 40	per cent.
Rolled oats ... ... 5 per cent. Whole oats ... ... 5 per cent.	 10	per cent.
Linseed oil cake meal	10	per cent.
Whole wheat meal	25	per cent.
Meat meal	5·5	per cent.
Lucerne meal	6	per cent.
Bone meal	2	per cent.
Salt	0·5	per cent.
Calcium carbonate	1	per cent.

The concentrate ration may be considerably modified if necessary. If no wheat meal is available for instance, the maize may be raised by 6 per cent., oat products to 12 per cent. and the lucerne meal to 10 per cent. A simpler mixture that has also given excellent results is the folowing: Rolled oats, 65 per cent.; wheaten bran, 20 per cent.; linseed cake meal, 12 per cent.; bone meal, 2 per cent.; lime, 0·5 per cent. and salt, 0·5 per cent.

The concentrates are fed in the fore-noon. About 70 grams per rabbit is put into the feed pan, to which is added approximately 100 grams of dry lucerne hay.

In the afternoon the feed pans are cleaned and greenfeed given on the basis of about 200 grams per rabbit. Clean water must be available at all times. The greens are fed during the afternoon because they are generally frosted on winter mornings.

Both guinea-pigs and rabbits consume considerable amounts of the veld hay bedding. For this reason all hay should be free from moulds and of good quality.

It is assumed that the rabbit represents an intermediate stage between the true ruminant and the equine. By re-consuming the soft night faeces the rabbit is able to increase its consumption of vitamin B and available protein which has been synthesised by the intestinal bacteria. This act, known as coprophagy may be considered to be of considerable benefit as indicated in Table 2 [by J. T. Abrams 1950)].

TABLE 2.

Analysis of Rabbit Droppings.

	Firm Pellets.	Soft Faeces.
	%	%
Crude Protein	10·92	34·97
Ether Extract	4·10	3·55
Crude Fibre	35·53	13·89
Nitrogen-free Extract	41·10	36·59
Ash	8·35	11·00

(On dry-matter basis.)

Non-breeding rabbits or those kept in the colony as available, may be fed very cheaply for short periods as indicated in Figure 12.

These curves illustrate the average weight gain of 10 weeks old rabbits. There were six animals to a group on the given rations for six months. The beneficial influence of greenfeed is clearly evident.

The importance of liberal supply of good quality feed is shown in Figure 13. The depressing influence on the growth of rabbits was due to reducing the diet of the young during the first two and three weeks of their lives respectively. This same deleterious effect is frequently seen in large litters that are unable to receive as much milk from the mother as do the individuals of smaller litters.

It may be advisable to take daily weights of rabbits in order to be sure that satisfactory gains are being made.

(5) *Ferrets* (Mustela putorius var. furo).

The breeding season for ferrets in South Africa is from September to March. Hammond and Marshall (1930) found that oestrum was prolonged in the absence of coitus and might even extend to five months. Like the cat and rabbit, the ferret only ovulates after coitus. If the young are destroyed at birth a ferret may come into oestrum within nine days, but while suckling it remains in anoestrum. Murray (1941) considered successful mating to occur about two to three weeks after the onset of oestrum, when the vulva is enlarged to fifty times its normal size. Although the vulva is a good indication as to the best time for service, it has been found that fecundity is not influenced and that successful breeding takes place at any time that the female will accept the male.

The male and female ferrets may be run together during the anoestrus period in order to ensure early mating. At the commencement of the breeding season one male may then be left with five or six females. The average gestation period is 42 days. At birth the average weight is approximately 10 grams. The eyes of baby ferrets open between the 4th and 5th week. Ferrets born in one season will breed during the following season and as indicated by Murray (1941) it is possible to have two litters from a female during a particular breeding season.

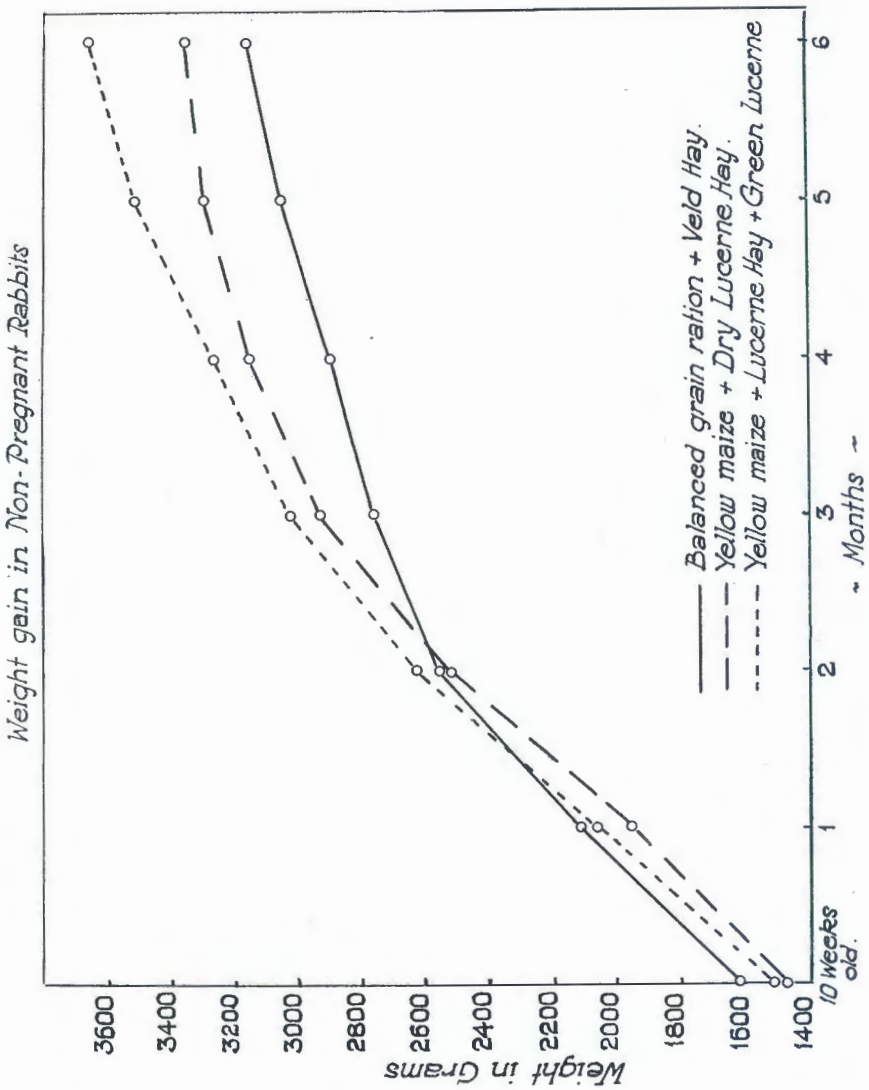


FIGURE 12.

When about three months old, ferrets are weaned by putting them into other cages and seeing that overcrowding does not take place. The advantage of this system is that the young become accustomed to their surroundings and sexing at birth is not necessary. The question of providing artificial light to stimulate oestrum is one which does not affect the issue in South Africa as there is an overabundance of sunlight.

Pregnant females may be removed to individual pens. As a rule they become nervous and easily irritated. After parturition they should not be disturbed unduly or they may even turn on the young. The average litter size is six.

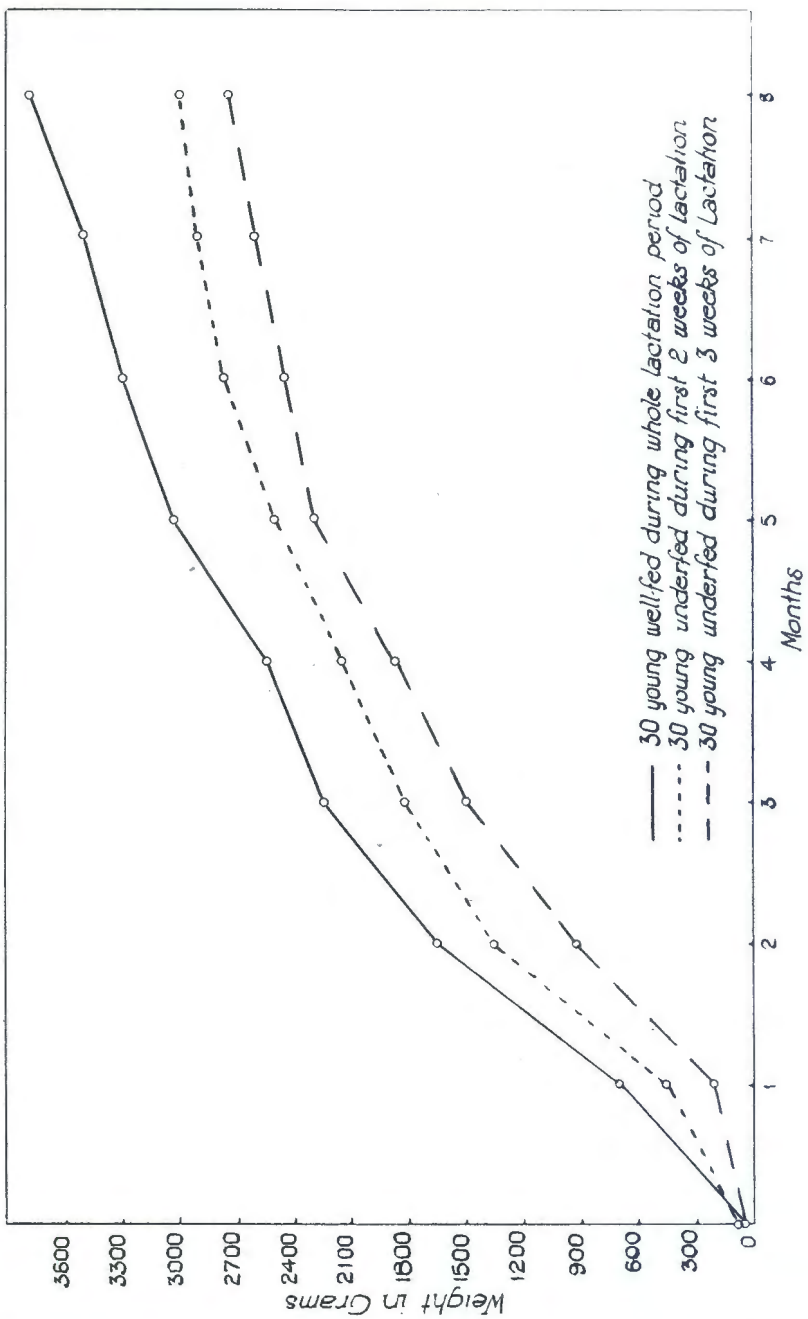


FIGURE 13.

Ferrets become accustomed to the daily routine of cleaning cages and feeding by a particular assistant. If incorrectly handled they may inflict serious wounds by their sharp teeth and claws. If inspection is necessary it is safest to lift them gently by the tail.

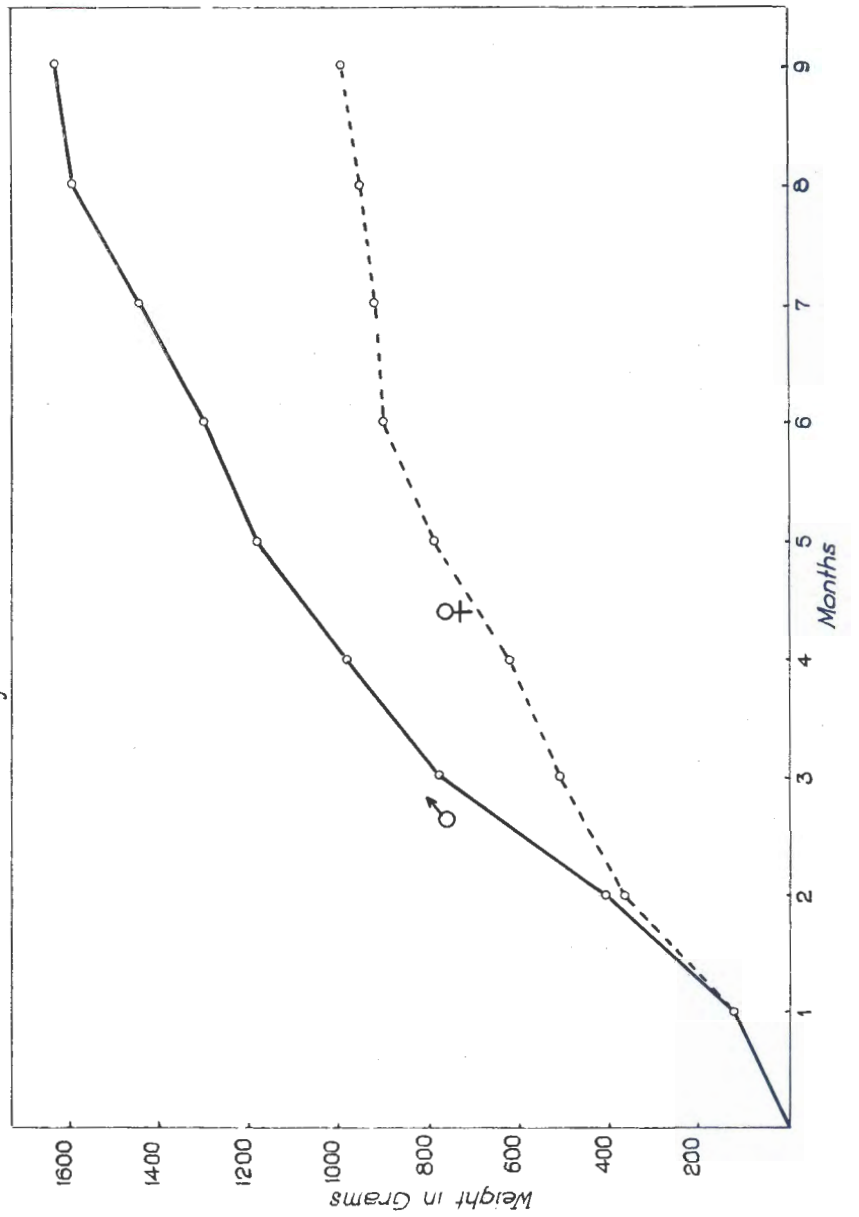


FIGURE 14.

The male and females will not molest each other unduly during the anoestrum period, but should be separated when the females have been served.

In general, ferrets are fed on much the same principles that would apply to dogs. Basically they are carnivorous animals, but have actually adapted themselves well to an omnivorous diet in which cooked cereal grain is used in the form of porridge. They do not digest raw meals well and are likely to develop a diarrhoea if fed rations containing uncooked cereals.

At birth the ferret weighs about 12 grams and if properly nourished, will gain three grams daily. At 19 days of age the young start nibbling, and will come out of the nest to join the mother at her feed when they are a month old. A normal weight curve is shown in Figure 14.

All ferrets at Onderstepoort are fed meat at least twice per week. One of these meat diets consists of minced horseflesh, mixed in maize meal porridge in more or less the proportion of 2:1. Milk is added to this diet in a separate container or may be poured on to the porridge.

The following is an example of a satisfactory feeding schedule:—

1st day: Minced meat, porridge and milk.

2nd day: Porridge and milk.

3rd day: Minced meat, porridge and milk.

4th day: Porridge and milk.

5th day: Freshly killed whole old guinea-pigs and/or entrails from freshly killed animals.

6th day: Porridge and milk.

It is essential that ferrets be given an opportunity to devour different organs and entrails. In this way their vitamin and mineral requirements are met. Favourable results are obtained by fasting ferrets on the 7th day.

Fresh, clean water is at all times necessary in warm climates and the ferrets seem to enjoy a bath in this water as well.

When guinea-pigs are available they are used for feeding, otherwise freshly slaughtered animals such as horses are used. Chilled meat must be allowed to thaw, be minced and then used mixed with the mealie meal porridge.

The quantity of feed consumed by ferrets will naturally depend on their size. They will take op to 100 grams each per day and 4 oz. of milk. Lactating females generally consume more feed and if not given sufficient, are apt to lose condition and milk flow.

Fuller details of the nutritive requirements of small animals are given in the valuable treatise on animal colony maintenance by the New York Academy of Sciences as edited by R. W. Miner (1945).

(6) *The Golden Hamster* (Mesocricetus auratus).

In 1949 eight females and four males were imported from Compton, England. The first mating took place two days after arrival and a year later there were over a hundred hamsters in the colony.

A suitable type of all metal breeding cage is shown in Figure 15.

The back compartment is almost dark when closed and gives sufficient ventilation through the opening in the partition, without draughts.

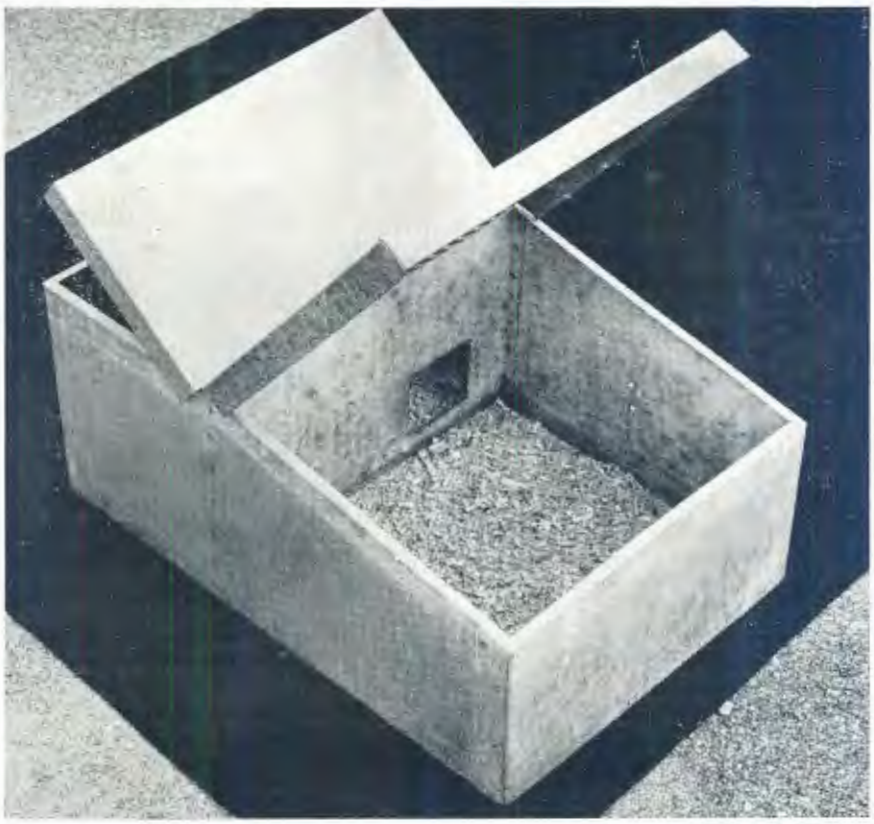
The stock animals may be kept in larger cages as long as the sexes are separated. They should be supplied with plenty of veld hay as bedding.

Hamsters are bred at 10 to 12 weeks of age. A male is usually introduced into the cage of the female and left with her for about 10 days or until she is noticeably pregnant. The average gestation period is about 16 days. Although copulation generally takes place at night, it has been observed during the day

and is similar to that seen in the guinea-pig. Young females appear to be the better breeders although first litters are small. After the third litter, females become poor breeders at about nine months of age. Although litters up to fourteen are not uncommon, the average litter size is probably about six. When born the young are naked and weigh about 2 gm. The first hair appears at five days and the eyes open at 11 days. The young may be weaned at three weeks old.

FIGURE 15.

Breeding Cage for Hamsters.



The hamster relishes variety in its feed and due to its harvesting habits, it is important to take out all old feed and clean the cage daily. It consumes relatively large amounts of greens and a regular fresh supply is of importance. The greens may be varied, and young sprouted grain, including the roots and soil, or a little raw carrot is given occasionally. The mouse biscuit is part of its daily diet. In addition dog biscuits may be soaked in milk and fed to hamsters.

In the hamster colony at Onderstepoort *Liponyssus bacoti* infection has been most troublesome. Dusting with pyrethrum powder seems to be most effective. Other specific infections have not made their appearance.

HYGIENE.

The old adage that " prevention of disease is better than cure ", cannot be emphasized strongly enough. Introduction of new stock should be kept to a minimum and if necessary, animals should be obtained from a known and reliable source. It is essential that animals introduced into the colony should first be kept in quarantine. Although no new mice have been introduced into the Onderstepoort colony for 15 years, birth weights, litter sizes and growth are regarded as normal. This is due largely to the rigid selection of the breeding stock.

Tumours.—In breeding mice and rats selection has to be applied very strictly to control the incidence of mammary and other tumours, which may otherwise become prevalent in the colony. Whether malignant or benign, the only effective method in reducing the percentage incidence is by strict culling of all animals showing signs of tumours. If all breeding stock that shows a tumorous tendency is destroyed, the condition may be almost entirely eliminated in young stock and considerably reduced in older animals.

Pyogenic Infections may also become troublesome at times and can be prevented by careful management of males and females during the breeding season in order to minimise wounds as a result of fighting. The cleanliness of bedding requires special attention. For example wood wool and teff hay are unsatisfactory nesting material for ferrets. The former has a tendency to cling to the newly born young and may become entangled with the umbilical cord so that there may be as many as five young all tied together. The struggling causes infection at the navel and the young invariably die. Teff hay has numerous barbs that may penetrate the skin and set up infection.

Salmonella typhi-murium infection easily spreads in overcrowded cages, which are difficult to keep clean. It is advisable to change animals into clean cages periodically.

Deficiency diseases should naturally be avoided. Although no actual deficiencies may be noticeable, borderline levels of intake contribute markedly to susceptibility to infection or lowered fecundity.

Diarrhoea is sometimes due to a diet that is unsuitable for a particular species. More often, however, diarrhoea may be due to food becoming rancid. Musty or mouldy feeds should on no account be fed. Such feeds may not only destroy vitamins such as A and E, but may result in sudden mortality. Sudden changes in feed, especially of green feed in the case of rabbits, is a common cause of diarrhoea.

Ecto-parasites are the most troublesome pests in a small animal colony, especially during the hot summer months. *Liponyssus bacoti* (Hirst) attacks rats, hamsters and mice. As these mites live in cracks and soil, all possible crevices should be painted over. The use of pyrethrum powder on the animals as well as the bedding has been found most effective. Rats in particular are liable to attack by *Notoedres muris Méguin,* which affects the ears principally and if neglected may prove fatal. Benzine hexachloride in suspension form has been found a very effective remedy. Ferrets are prone to become infected with *Ctenocephalides canis* (Curtis), against which pyrethrum powder seems to be effective. Good results have also been obtained with dilute D.D.T. spray. Continual vigilance must be maintained against the bug *Cimex lectularius* Linné in the mouse houses. Workers should be provided with a cement-floored and ceilinged change room where they change into overalls for duty. The walls and ceilings of mouse houses should be

washed down or sprayed with one of the new synthetic insecticides at intervals. All ecto-parasites may be fairly well controlled by the systematic sterilization of the cages.

In the rabbit, two forms of mange may become troublesome.

1. Ear canker, which is caused by *Psoroptes Cuniculi* (Delafond); and
2. Body mange which is caused by—
   (*a*) *Sarcoptes scabiei precox* Canestrini; and
   (*b*) *Notoedres cati var. cunicul.* Gerlach.

In the latter condition it may be advisable to destroy affected animals. The most effective preventive measure is the previously described weekly burning of the bedding in the hutches.

Although other varieties of blood sucking lice (Anoplura) may occur on mice and rats, these pests have not been a problem at Onderstepoort because of the strict hygiene. For the same reason ticks have never become a problem.

An outbreak of coccidiosis may prove very serious among rabbits. Here again, prevention is better than cure and is effected by the regular cleaning and disinfecting of hutches, the provision of sufficient floor space, by *adequate ventilation* and avoiding feedstuffs that may have become contaminated.

Although there are several internal parasitic conditions of small animals, such conditions have never given serious trouble. This may be attributed to the regular and frequent changing of bedding and the disinfecting of floors and cages.

Although the worm *Graphidium strigosum* in rabbits does not occur in South Africa *Taenia taeniaeformii* in mice has been observed. This condition has disappeared without specific treatment.

It must be emphasized that laboratory animals are susceptible to a large number of infections. Therefore, the small animal colony must be strictly isolated from contact with other animals, both domestic and wild.

Full information on the diseases of small laboratory animals is given in the U.F.A.W. Handbook by A. N. Worden (1947).

Recommendations.

A successful small animal colony can be established and maintained only if a policy of strict isolation is practised. For this reason laboratories should become self-supporting as far as their requirements of small animals are concerned.

It is evident too, that uniformity of stock issued for experimental as well as routine purposes is of paramount importance and can be realized only by certain standard breeding and feeding procedures.

The maintenance of health is to a high degree dependent on proper hygiene and feeding. Housing should suit warmer climatic conditions and in certain animals, such as mice, be equipped so as to avoid sudden drops in night temperatures during the winter months. The proper periodic sterilization of buildings and cages against ecto-parasitic invasions should be regarded as a most important routine.

Last, but not least, assistants should be observant, conscientious men who have a natural aptitude for handling the small animals and a liking for it.

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