in new studs and is commoner in the Spring. It will respond to **Tetracycline** providing enough is given.

I do not believe in culling snuffling rats because either it is a case of locking the stable door after the horse has bolted or the rat is not infectious anyway and is perfectly capable of breeding. In the case of epidemics it could mean culling the whole stud. In the last case it is probably best to cull the worst affected rats that are unlikely to make a good recovery. The others, however, should develop immunity. It is so widespread in the Fancy that as a means of disease control culling is doomed to failure. However, if you have an infectious disease in the stud you must **not** show or sell any of them in case you pass the disease on.

RINGWORM: This is not caused by a worm but a fungus. The skin becomes scaly, raised and sometimes discoloured. In rats, it is commoner on the ears, tail and feet. This was common in the old Rat Fancy when it was called **Scaly Tail** or **Ear.** It is extremely rare now which is good as it is very contagious. Traditionally it was cured by the use of an ointment made up of vaseline, flowers of sulphur and 'Jeyes Fluid'! Now very good anti-fungal creams can be used such as **Tinaderm,** which is available from the chemist. Alternatively a vet can prescribe a drug such as **Griseofulvin.** Infected ears are unfortunately left with a ragged edge even after treatment.

RINGTAIL: This condition does not occur to my knowledge in the U.K., but in countries with low humidity. The tail end becomes dead and drops off. Various lengths of tail can be affected. The areas of tail just before the dead end often swell up.

S

SPOTS: These occur on the head, neck, shoulders and back of the affected rat and are scratches caused by the rat's claws. Rats scratch themselves for two main reasons; Mites (see Mites) and high fat foods. Too many sunflower seeds or peanuts in a rat's diet causes skin irritation. These should only be fed as a treat. Affected rats should have their claws cut, be dipped in an anti-mite preparation (see Mites) and be fed a low fat diet for a couple of weeks.

SCALY TAIL: See Ringworm.

T

TAPEWORM: There are several species of Tapeworm that pets can get but only if they have access to wild rats' fleas. Rats with Tapeworm may be **Asymptomatic** or be 'non-doers'. Tapeworm segments, that resemble grains of rice, may be seen in the rats' droppings. Cat Tapeworm treatment tablets may be used but a vet can provide better treatments. Rat Tapeworms of the genus *Hymenolepsis* can infect humans.

V

VITAMINS: Rats need Vitamins A, B, D, E and K, but not C. Most of these are freely available in the rats' normal diet (see Feeding). Vitamin K, which may be available in low amounts in the diet, is available in the rats' droppings, as Bacteria present in the colon produce it.

Shortage of vitamins can cause many symptoms, depending on the ones that are lacking. Commonest symptoms are sparse or dull coat and infertility.

If liked, a vitamin and mineral supplement can be used. Best are **'Vitapet'** (A, D and E) and one of the Seaweed powders (which contain lots of minerals). Remember, however that most commercial feeds (Vitalin, Winalot, Rabbit Mix, Dog Chow) contain added vitamins and so a supplement is not really necessary if you use one of these.

That's all for now. This is not a comprehensive list of rat illnesses and cures and I intend to update and enlarge it at some future point.

BREEDING FANCY RATS

BREEDING

By Ann Storey

In the beginning . . . there was a buck and a doe. Fair enough, some may say, that is all that needs to be said regarding breeding. If, however, one wants to rear good healthy kittens or if you are trying to breed show stock, it helps to know a bit more.

A rat can reach puberty as early as six weeks, although seven is more usual. At this age a doe is not anywhere near physically mature enough to raise a litter and it is best to keep them separate until they are at least five months old, when they are old enough for breeding.

BUCKS

Like other mammals, male rats are provided with two testicles which, in the rat, descend into the scrotal sacs from cavities in the abdomen at the age of three to four weeks. For another two weeks they are still liable to 'disappear' upwards at times of stress. Testicles have to hang outside the body cavity because spermatozoa do not grow if they are kept at body temperature; requiring a cooler environment. This is the reason why bucks are not quite as fertile during the hot summer months as during cooler times of the year.

Sperm production begins shortly after the testicles have descended, as does production of a hormone — testosterone — which brings about changes to make the buck rat look different from the doe.

Compared to the doe, bucks have a larger, heavier frame and a greater tendency to put on weight. Their heads are broader, muzzles blunter and coats considerably coarser. Adult bucks have a brown layer of skin under the coat.

As regards breeding for show, a stud should aim to have as few stud bucks as possible; 10–15% of the total rat population should be about right. These should be the cream. As a contrast to the athletic, racey doe, a buck should be heavy and muscular, without being fat. Never use small 'seven stone weaking' type bucks, only use large boned bucks with a broad skull and a fairly blunt nose. When viewed from the side there should be a definite shoulder and smoothly arched back and from the top a broad back without too much suggestion of a waist. This large thickset animal should, by the time it reaches full maturity at seven to eight months, be about 37cm in length and weigh in the region of 500g.

A buck should excel in as many departments as possible and any doe that he mates with should excel where he fails. If this all sounds like a tall order, remember that a stud is like a stallion or a bull, he will have a profound effect on your stud simply because of the number of offspring he is capable of siring. A poor buck can ruin a stud and just as not all male calves make bulls, not all male kittens make stud bucks. Never use a second rate buck. If you can't find a good buck amongst your own rats, borrow someone else's.

DOES

Does have a five day oestrus cycle. This means that every five days an adult doe releases several eggs from her ovaries down into her two-horned uterus (if she only had a human type uterus she would be unable to have as many kittens). At this time a doe comes on heat. Normally, a doe will not allow a buck to mount her, however, ovulation coincides with the release of a hormone designed to make her more receptive. A doe on heat will, from time to time, 'freeze', jump sideways and vibrate her body — especially the head and neck region. If you examine a doe's vagina when she is on heat the area will probably be a mauvish colour and the mouth of the vagina gaping open as opposed to the normal pinkish colour and almost unnoticeable entrance. This is the time to mate your doe.

If you are breeding for show, choose a doe who is fully adult, about five to six months for a first litter and not over eighteen months (when a doe reaches the menopause). Only breed from a fit doe with a glossy coat, no fat and looking as though she could run a marathon. A fit animal has a firm, lively feel when picked up. Do not use does in poor condition, heavy moult, snuffles or other illnesses. Another thing is that it is very easy to overfeed and most older does are carrying a bit of surplus. Any suggestion of tummy lessens a rat's chances of pregnancy, because fat builds up around the ovaries and the eggs may not find the entrance to the oviducts.

So, your doe is lively and fit — what else does she need? Apart from breed characteristics (which will be discussed later), she should be of good type. The type standard is: 'The rat shall be of good size, long and racey in type, arched over the loin, firm fleshed with a clean, long head, but not too pointed at the nose. The ears shall be of good size, well formed and widely spread. The tail shall be as long as the body and cylindrical, thick at the base and tapering to a fine point. The eyes shall be round, bold, clean and of good size. The ears, feet and tail shall be covered with fine hair. The coat shall be smooth and glossy.'

So we are looking for an alert, racey animal with large ears, round prominent eyes, smoothly arched back and a whiplash tail, which is often too short. To measure the tail, bring it up over the rat's back. If it does not reach at least to its crown, the tail is too short. Another fault is matchstick tails. These tails are square in appearance instead of round and are usually thin at the base and poorly 'set on' to the body. A tail should look as though it is part of the body, not stuck on as an afterthought. The rump should slope into the tail, not looking as though it has had a lump chopped off it. These faults also apply to the buck, but are often more pronounced in the doe.

When choosing a doe, don't go for the 'well balanced' animal with an average tail, average head etc, and no outstanding feature or you will end up with 'average' kittens and eventually an average stud. Go for a rat that excels in a couple of departments, even if she has one or two faults, and mate her to a buck which excels where she fails and also, if possible, has the same good characteristics as her. Never mate two rats together which have the same fault. One mistake made by a lot of people is to keep their best does for showing and using their second rate does for breeding. While everybody wants to give their best does a fair chance of winning, don't go on showing her until she is ready to draw her pension. Retire her at about eight months, before she is too old, so she can have a chance of breeding even better rats. Don't use rats with a lot of faults unless you absolutely know what you are doing or have a fantastically good buck. Does for breeding should be at least 34cm long and about 300 grams in weight.

MATING

The simplest method used to pair your rats up is to cage buck and doe(s) together until the doe(s) are obviously pregnant. This method is wasteful of cage space however, as the buck may have to remain by himself after the does have been removed. If he is reintroduced to other bucks, no matter how carefully, you risk a serious fight with possible fatal injury. This method is okay if you have a buck living by himself or a lot of does you want mated. The best method is to put buck and doe together in a spare cage (show tanks are ideal) when the doe is on heat. Put them together in the evening and leave them overnight with the minimum of food or the buck may lose interest in sex. In the meantime you may see a whitish, rubbery plug in the doe's vagina. This is normal and will disappear in twenty-four hours. Both rats can now be returned to their normal cages.

If the mating has not 'taken' it can be repeated when the doe comes on heat again, four to six days later. If the doe has not come on heat again in twelve days she is probably pregnant.

PREGNANCY

The gestation period lasts 21–23 days after mating, although occasionally it may be a week or more longer than this. You should see a sideways enlargement of the belly in front of the flanks sometime during the second week and by the third week you will be able to feel the heads of the embryos lying on either side of the belly.

Keep the doe fairly quiet during pregnancy and during the second week separate her from her fellows and put her into a fairly small cage. Don't overfeed her but make sure she gets plenty of protein, you could add a vitamin/mineral supplement if you wish.

Before giving birth she will begin serious nest building and may be off her food and have a staring coat. A discharge at this time probably means almost imminent birth. If a doe is still discharging with no result twenty-four hours later, take her to the vet.

Kittens are born head or tail first — both are normal. The umbilical cord is often broken before birth, otherwise the doe bites it off. Birth is usually completed in under two hours. As most births occur at night it is something you will see only rarely but it is well worth watching.

At birth, healthy kittens will be a bright pinky-red colour and very eager to feed. All baby mammals are born with little or no resistance to disease but they receive passive immunity to infection through mum's milk. This is especially true of the first milk, or colostrum, and it is extremely important that the kittens receive this.

A few hours after birth remove the doe and examine the litter. A healthy kitten will be lively, a good bright colour and will have a large pale patch showing through the skin half way down the abdomen on the left. This indicates the kitten has recently been fed, the pale patch is the stomach. Don't disturb the litter more than is necessary, but remove any dead or sick kittens. Check the doe over to make sure she is alright as well.

Doe and litter

The doe will often eat only sparingly on the first day, so give her something nourishing like bread and milk or gravy but make sure she has plenty of liquid.

If you are leaving the buck with the doe, remember the doe comes on heat immediately after birth (post partum oestrus). However, this is not like other heats as the doe is frequently not at all keen on having her mate anywhere near her. If the buck does succeed in mating her the new litter is quite often abandoned after a couple of days unless the doe loses her litter.

A doe will have an average seven to nine in a first litter and more in subsequent litters until about fifteen months of age, when the numbers will drop, Maximum numbers are in the twenties but twelve to fourteen is more usual. A doe has only twelve nipples so it's sensible never to let her keep more than twelve whatever your viewpoint on culling.

Some very successful studs cull litters to eight or less kittens and others, equally successful, do not cull at all. Kittens from culled litters grow larger and faster than those from unculled and are ready for showing about four weeks earlier. However, by the time they are adult there is usually not much difference in size.

Allow your doe plenty of bedding so that she can decide on the size of nest necessary to keep the litter warm. Feed her ad lib on a good nourishing diet and make sure she has plenty of water — she needs it for her milk production.

Fur starts to grow from birth, which is why dark coloured rats have a greyish colour from the age of about two days. The coat is not really noticeable until the rat is about a week old. At ten days the kitten will be completely covered in a plush fur coat and resemble a young puppy — hence the laboratory name for them is puppies! At fourteen days their eyes will begin to open and they will start to crawl around the cage looking for things to eat. Feed them on mashed potatoes or bread and milk or porridge. Mother rat will put food in the nest to encourage them. She transports them around the cage by carrying them in her mouth, but after three weeks they become too heavy and boisterous to be carried. Some mothers never carry them but they have a good sense of smell and get back to the nest alright. I always put a first time mother into a small cage by herself, she will find it harder to ignore them. Also, babies which get out of the nest will not need to go on a route march to get back.

Rarely, a doe will eat her litter — or parts of it. This is nearly always caused by stress; presence of a cat or dog, too hot, too cold, too much disturbance of the litter. If it is going to happen she will do so within the first three to four days. However, having said this, if your doe doesn't mind, handle the litter as early as possible. Does also eat their babies if they are deformed, sick or dead, but this is natural.

The general timetable of a litter is as follows:

Opening of ears	2½–3½days
Incisors break through	8–10 days
Eyes open	13–16 days
Genitals covered in fur	16 days
First molars through	19 days
Second molars through	21 days
Third molars through	35 days
Migration of testicles	21–41 days
Opening of vagina	42–72 days
Average life span	1,000 days

With practice it should be possible to sex a litter from birth; many people like to cull most of the bucks. The best way to tell them apart is that does have nipples and bucks do not, also the distance between the anus and top of the urethra is shorter in does than bucks.

Culling should not take place before four days old, by then the doe will have geared her milk supply for her litter size. If the litter is reduced to half, they will all get double their normal milk supply. Rearing a large litter should not unduly strain a doe if she is receiving an adequate diet. Leaving a litter with the doe for more than five weeks is not a good idea as the doe steals the food meant for the kittens and seems to get fat overnight. Take her away and rest her for a week or so then you can mate her up again.

You should wean the kittens at five (5) weeks of age, and give them as much nourishing food as possible to feed them up. Kittens from culled litters may be left with the doe another week.

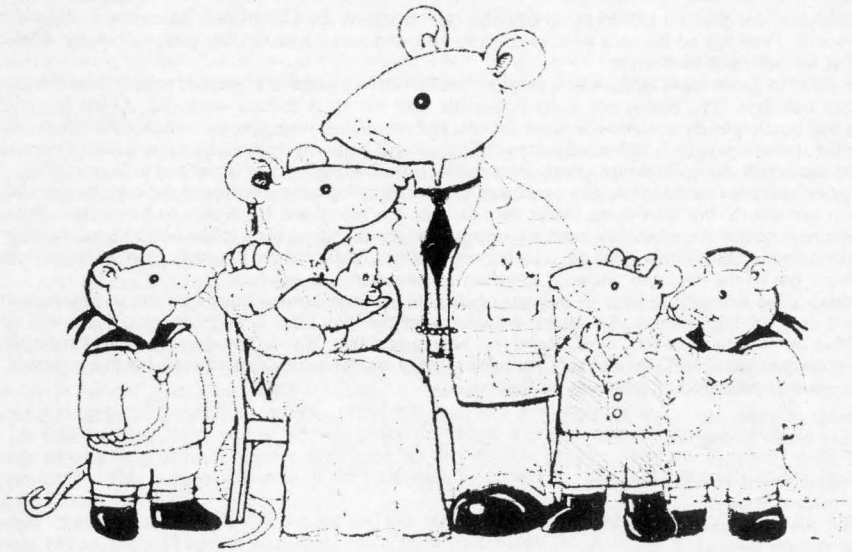
At weaning it is possible to select any marked exhibits you wish to keep, the others can be culled or sold as pets. Some colour varieties can also be selected at this age and any rats with bad type faults can be discarded. Get any kittens you wish to keep used to being held, as tame rats grow faster than nervous ones. Several litters (sexed, of course) can be mixed together at weaning. Watch out for sick kittens or any kitten that is thin or a non-doer. Several bugs causing epidemic diarrhoea can infect kittens and breeders should look out for this. Sick kittens and non-doers are best culled unless you have a good vet and the time and inclination.

Before showing wait until the kitten is about eight weeks old. Don't show them in heavy moult or if they are skinny or small. Some rats, e.g. Silver Fawns, are very pale and boring in colour until at least ten weeks old.

As they get older you will be able to see what rats you want to keep and what are no good. With practise you will be able to do this from an earlier age. At thirteen weeks the rat officially becomes an adult. Some rats are too big for the kitten class before this and others still look minute at thirteen weeks. If the rat is big enough, it can go straight into adult classes, otherwise leave it at home until it is bigger.

Does usually make the best show animals and, depending on the variety, can be shown until they are a year or more old. However, they should be allowed to litter well before this. Some rats will make a good return to the show bench after kindling.

Bucks can be shown successfully until they get a spiky coat. The age varies, if the buck is long coated to start with it can go spiky very young.



The happy family.

INBREEDING

By Ann Storey

Like genetics, inbreeding is a much maligned topic, but if used correctly the benefits are enormous.

Inbreeding is the mating together of relatives. There are four main types, close, moderate, weak and line breeding. Close inbreeding is the mating of brother–sister, father–daughter, mother–son. Moderate inbreeding, halfbrother–sister, uncle–niece, grandparents–granchildren etc. Weak inbreeding, this is more distant pairing, the mating of cousins etc. Line breeding, this is where attention is paid to an outstanding male or female and its offspring are mated back to it. The rats from this litter are then mated back and so on. Practically, does will be able to mate with a maximum of three generations and bucks with four. This way with the doe resulting fourth generation will be 93.75% the original doe and the bucks resulting fifth will be 97% the original buck. Normally, only about two generations would be bred back, giving a final percentagea of 87.5%.

The object of inbreeding is to fix desired points in type, colour etc and so to found a 'strain'. A strain is a collection of home-bred animals all so alike in general appearance that they are distinguishable as being of a certain ownership. It goes without saying that you can have good and bad strains. This article is to help you found a good strain and avoid the bad. It is impossible to found a strain or even fix desired points without at least moderate inbreeding. For inbreeding to succeed and for a good, worthwhile strain to be founded, strict attention must be paid to detail and to selection of breeding animals. First you must set a standard and any rats which fall below this must not be bred from whatever their breeding and relationship to the rest of the stock. It is a common mistake to mate together rats just because they are son–mother etc without paying any attention to their suitability. As I have said before, never mate together rats with the same faults as this is the quickest way to fix that fault. This is essentially true in inbreeding. Inbreeding tends to proceed towards homozygousity and this means that any recessive factors hidden in your stock will come to the surface. Some of these factors will be good, but the majority will be bad. These include things such as: nervousness, kinked tail, long coats, infertility, short tails etc. These things tend to show up in about the second to fourth generations of inbreeding. Many people see this and rush for an outcross when in fact this is really too early. The first thing to do is chuck out anything showing an undesirable trait and to go on selecting for the best.

Continued inbreeding tends to show loss of hybrid vigour, e.g. fitness, fertility, disease resistance, longevity and size and after six or more generations you may feel that an outcross is desirable. Choose an outcross at least equal to your own stock and with all the characteristics yours are lacking. Preferably choose a rat from another related inbred strain, this way you will get maximum benefit of hybrid vigour. Mate the rat, preferably a buck, to a few selected does. If the resulting offspring are satisfactory, mate these to selected individuals and so on. Always keep these rats separate until you are sure that the outcross is satisfactory. Never put your outcross on every doe in sight because this is a sure way to complete disaster.

If your strain is very far gone or if the outcross is superior to your own stock you can practise a greater degree of outcrossing known as grading. This involves mating the progeny of the outcross back to the outcross and line breeding from him. In this way the old line is practically wiped out by the new.

Another reason to outcross is if your strain is lacking in some point or another, e.g. they have small tails, then the best thing to do is to get in a rat from a strain that excels in good tails without failing too much on other points. It is important to remember that inbreeding does not create, it can only work on the points already there, it does not add anything. It should be remembered that whole varieties have died out because breeding failed to see the 'warning light'. This happened with the variegated mouse which became infertile due to faulty inbreeding.

The best way of outcrossing is to breed two or more separate lines that have a common ancestor and to 'outcross' to these lines when it becomes necessary. When you obtain your foundation trio you can obtain rats from relatively unrelated stock and attempt the foundation of an entirely new stain or obtain a trio from an established strain. Which ever method you use try to develop two strains, one from each doe, with the buck as the common ancestor. Foundation stock must be the best available.

The best scheme is to employ all four types of inbreeding and very occasional outcrossing at need with more emphasis being placed on the rat's appearance when choosing a mtae than its relationship. Also important is the rat's pedigree — going back to the short tailed rats, the rat chosen to correct the fault should have no suggestion of poor tails in its pedigree at all, apart from its own good tail.

There is no reason for size to be lost, one of the biggest show strains with large litter size was inbred and many 'giant' lab strains are brother-sister mated for 20 plus generations.

As a rough guide:

1. Obtain your trio, the best available, with all the points necessary in them to make a good strain when combined and get a more experienced fancier to help.
2. Mate the buck to the two does. Keep the best buck and the best two does from each litter.
3. If they are good enough, mate the sons back to their mothers and the daughters to their father. Keep only the best from the four litters.
4. Now you have a choice of bucks and does but remember to keep the lines from the two original does seperate.
5. Do not expect winners in the first few generations and if you do get them treat it as a bonus.
6. Go on breeding down the two lines always selecting the best and do not be afraid to discard or stop using an older rat if new ones are better.
7. Don't be afraid of asking for help.
8. Do not use show success as a criteria for selecting breeding stock, I go more on your own records and knowledge of a rat's breeding when pairing.
9. When you think you need an outcross, think again. If you're sure, use a rat from your other line.
10. Your two lines should be at least as good as each other, maybe in different ways, but don't get a first strain in a poor second strain.
11. First, obtain a copy of *Practical Inbreeding* by W Watmough — available through Fur & Feather.

'She loves me, She loves me not . . .'
(Getting the genetics right . . .)

GENETICS

by Ann Storey

An animal's genetic code is, if you like, it's blueprint or plan. Every aspect of a rat's development, type, size, colour etc is governed by its genes. Providing an animal is given an optimum environment it will follow its blueprint.

The only rat genetics I will discuss here are those **genes** that affect colour and coat. It is useful to know them and their effects so as to know the likely result of pairing two different colours or to know how to propagate a new colour.

In each body cell an animal or plant has a certain number of **Chromosomes**, in the rat's case this is forty-two. Chromosomes are spirals of **D.N.A. (Deoxyribonucleic Acid),** the genes are short lengths

of this spiral. So, as you see, the rat has thousands of genes. A gene codes for the production of protein — this protein may be structural, such as for muscle or hair, or functional, such as an enzyme responsible for part of digestion. I did say that the rat's body cells contained forty-two Chromosomes, but this is not true for all the cells. Both sperm and egg contain only twenty-one Chromosomes, this is because they have under gene 'reduction divisions', which halves the Chromosome number. At fertilization, the sperm penetrates the egg and the nuclei of the two cells fuse — then the Chromosome number is again forty-two. If there was no reduction divisions, the Chromosome number would go on doubling with each generation. If we were to examine a cell's Chromosomes, we would find there are two of each indicating that they are present in pairs — one of each pair comes from the male parent, and the other pair from the female. The position a gene occupies on the Chromosome is known as its **locus,** (plural: **Loci).** On the other Chromosome the same gene will occupy the same loci. Sometimes, however, an altered gene will occupy the loci. This gene will have an effect on the same area as the normal gene, but with different results. This modified gene is known as the mutant or **Mutant Allele.**

Given that the same gene usually occupies the same loci on the same Chromosome, when the other Chromosome in the pair contains the same allele as its partner, the gene is said to be **Homozygous.** If the loci on the two Chromosomes contain different alleles of the same gene, then the gene is said to be **Heterozygous.** In a heterozygous relationship, one of the alleles is usually dominant (ie: produces in effect the same as if it was in a homozygous relationship), and the other recessive. In this case the recessive factor will be hidden or masked in the animal. For instance, a Black rat can be carrying Albino, but will appear no different to a Black rat which is not. Both of these rats have the same **Phenotype** — that is they look alike but they have a different **Genotype** — that is one is carrying Albino.

It is normal to write the dominant allele with a capital letter and the recessive allele with a small letter — eg: CC full colour, cc Albino.

Often more than one mutant exists although only two alleles for the same gene can exist in a normal rat, eg: CC Full colour, ChCh Siamese, cc Albino. The alleles are written in order of dominance. Sometimes when two different alleles are paired, neither one is fully dominant, this is known as **Incomplete Dominance** and both alleles have an effect — eg: ChCh Siamese, Ch c Himalayan, cc Albino. The Himalayan is midway between the two having a lighter body and points to a Siamese. There are at least seven loci responsible for coat colour and one or two responsible for markings. Below is their effect, followed by the varieties and their geneotypes:

1. THE AGOUTI LOCUS — A

The rat has only two alleles at present, although there is evidence that in the past more existed. These are AA Agouti, aa Non-Agouti. An Agouti coat pattern is distinctive as it is composed of hairs of different colours. Varieties which have the Agouti gene are: Agoutis, Cinnamon, Cinnamon Pearl, Silver Fawn and Argente (Fawn). Non Agoutis produce rats of one colour, eg: Black, Mink, Champagne, Dove (Beige), Chocolate. Aa rats have Agouti coat characteristics and are indistinguishable from AA rats.

2. THE BROWN LOCUS — B

This locus in under research at the time of writing. There is every possibility that Pearl, Cinnamon Pearl, Mink and Cinnamon are on this locus. The allele responsible for the Pearl effect is incompletely dominant to Mink and Cinnamon, but recessive to Black. Chocolate, which exists on this locus in other Fancy animals may or may not exist here in rats. Rather than confuse people with possibilities, I would rather leave the discussion on this locus until it is completely worked out.

3. THE ALBINO LOCUS - C

There are three alleles at the Albino locus — C Full colour, Ch Himalayan, c Albino. The varieties they make are CC full colour rats, Ch Ch Siamese, Ch c Himalayan, cc Albino. This shows a gradual reduction in the amount of pigment that the rat is able to express. On Siamese and Himalayan rats, pigment is doubtful at the extremities (points), because this is temperature dependent. It had been said that Agouti pointed Siamese have Chinchilla coloured points. This is not true however. I have seen both Agouti point Himalayans and Siamese and they had **Agouti** points. Albino masks all other colour genes on all other loci. This does not mean however that they are not carrying them — rather the reverse.

4. THE DILUTE LOCUS — D

This is responsible for Blue and Silver in Fancy animals and while it has been described for rats, it does not exist in the Fancy at present.

5. THE PINK EYED LOCUS — P

PP Black eyed, pp Pink eyed. Apart from the effect on the eyes, pp also reduces Black to Champagne,

Mink to Light Champagne and very slightly lightens red pigment. Pp rats are the same as PP rats in appearance. Rats with pp include Silver Fawn, Champagne. Pink eyed Agouti and Pink eyed Cinnamon are both Silver Fawns but the latter are much paler in colour. On the same tack Pink eyed Black and Pink eyed Mink are both Champagne but the former are very pale.

6. THE RED EYED LOCUS — R

RR Black eyed, rr Ruby eyed. This is a new one in this country, but a well established one in America. The effect of the gene is similar to p, but not quite so intense. r reduces Black pigment to a pale Dove Grey and Mink to a Champagne colour, red pigment also seems to be slightly reduced. AA rr rats are Argentes with Dove Grey ticking. When the gene is combined with Cinnamon the resulting Argente appears lighter with Champagne ticking instead of Grey. Their eyes are, of course, Ruby. The Rr rats are not the same as RR rats when they are babies. Agouties carrying r are even more altered. The eyes are dark Ruby and the coat a Mink-Coffee shade. This does seem to change as the rats get older however.

Dove rats (Beige) appear to be aa rr and Dark Eyed Champagnes appear to be Mink carrying rr.

7. THE HOODED LOCUS — H

This is the major form of white spotting (as white markings are called in animals), and is responsible for all the Marked varieties. There are four alleles; H — Self, hi — Irish, h — Hooded and h' — Patched. Leaving aside h' which may **not** exist in the Fancy, the six possible geneotypes are:

HH	Self	hh	Hooded
Hh	Irish/Berkshire	h'h	Capped/Patched
Hh'	Variegated	h'h'	Patched/Black Eyed White

These genes vary considerably in the amount of white they can produce. Personally, I do not believe this is the whole story, as it does not explain the **American Berkshire** (a sort of halfway stage between ordinary Berkshire and Variegated) or the **Bareback** (Hooded minus a saddle). A minor white spotting gene causes the white spot on the forehead of Berkshires and the blaze or spot on the Variegated.

COAT TYPE

The only coat variation existing in the Fancy is Rex (Re). This is a dominant which produces a short, wavy coat with degenerate wavy guard hairs. The curling is present in young kittens and in rats over four or five months of age. In between times, however, it tends to be absent. It has been said that homozygous Rexes are bald. This is not necessarily true. What is true is that they tend to go bald when kittens for a few days before growing a new coat. Their coats are shorter than normal. All Rexes are prone to bald patches.

LIST OF SOME COLOUR VARIETIES

AA	BB	CC	PP	RR		Agouti
AA	BB	CC	pp	RR		Silver Fawn
aa	BB	CC	PP	RR		Black
aa	BB	CC	pp	RR		Champagne
AA	BB	CC	PP	rr		Argente (Dove Ticking)
aa	BB	CC	PP	rr		Dove
AA	BB	Ch	Ch	PP	RR	Siamese Seal Point
AA	BB	Ch	c	PP	RR	Himalayan Seal Point
Any	Any	cc	Any	Any		Albino/Pink Eyed White

SILVERS

There is no separate Silvering gene in Fancy rats but all rats are silvered to a degree anyway. Show quality Silvers are rats that have been selected for this point.

POLYGENES

These are groups are **Modifying Genes** which have small, but important effects. One important group is the **Rufus Group** — this controls the level of red colour in Agoutis, Cinnamons and Silver Fawns Others control density of pigment in Blacks, Minks and the amount of White in the Marked varieties. These are probably more important to the fancier than the more important, major genes, as they control the variation of colour within a variety.

PAIRING

What happens when two different rats are paired?

Black x Pure Agouti

The genotypes for each will be:

AA BB CC DD PP Agouti
aa BB CC DD PP Black

The only way in which the two vary is in the Agouti locus — all the rest can be disregarded. When the two are paired:

	Sire (Agouti)	
	A	A
	Aa	Aa
Dam (Black)	a	Aa Aa

(F1 Generation)*

All the litter will be Heterozygous Agoutis Aa. If two of the offspring are paired:

	A	a
A	AA	Aa
a	Aa	aa

(F2 Generation)* (*First/Second **Filial Generations**)

Three out of four kittens will be Agouti and one out of four Black. This is only a ratio and in a litter you may get any number of either, but in a series of kittens it would average out 3:1. Pairing one of the sons to a Black (perhaps the mother):

	A	a
a	AA	aa
a	Aa	aa

Here the ratio is 50/50. If the object was to breed more Blacks, this mating would be the better one. This method will work for all dominant/recessive relationships at a single locus. The exceptions are when an incomplete dominant is involved, eg: Siamese x PEW. We only need to bother with the one locus:

		Siamese	
		Ch	Ch
	c	Chc	Chc
PEW	c	Chc	Chc

All the F1 generation will be Himalayan. When two of the F1's are paired:

		Himalayan	
		Ch	c
Himalayan	Ch	ChCh	Chc
	c	Chc	cc

The ratio is 1 Siamese, 2 Himalayan, 1 PEW: 1:2:1.

The coat mutation Rex (Re) is a dominant and, as such may exist in the homozygous or heterozygous forms. To check if an animal is homozygous or heterozygous Rex, mate it to a normal coat. Homozygous Rex will produce a litter of 100% Rex, whilst heterozygous Rex will produce normal coated rats in the litter.

The white spotting which causes Hooded is an incomplete dominant to Self with HH being Self, Hh Berkshire/Irish and hh Hooded. Expectation if a Hooded is mated to a genuine Self is 100% Berkshire/Irish. If two Berkshire/Irish are paired the expectation is 25% Self, 50% Berkshire/Irish and 25% Hooded. The Irish gene hi can form Berkshire and Irish, but no Hooded will be produced in the litters.

VARIATIONS AT TWO LOCI

It is most likely that the majority of time you will be pairing rats which are different in two loci, ie: Cham and Agouti.

Agouti	AA	BB	CC	DD	PP
Cham	aa	BB	CC	DD	pp

The loci which are common to both rats can be disregarded.

When the Agouti AA PP is crossed to a Cham aa pp, the litter will be all Agouties of genotype Aa Pp. When the two rats from the F1 are paired the characters in each rat will be paired in the germ cells,

ie: A' Ap, aP, ap. So:

		Male			
		AP	Ap	aP	ap
	AP	AAPP	AAPp	AaPP	AaPp
	Ap	AAPp	AApp	AaPp	Aapp
Female					
	aP	AaPP	AaPp	aaPP	aaPp
	ap	AaPp	Aapp	aaPp	aapp

The top row — each genotype contains A and P, meaning they will be Agoutis. Second row — the first one AA Pp is an Agouti, second one AApp is pink eyed Agouti (Silver Fawn), third one Agouti, fourth Silver Fawn. Third row — first and second Agouti, third and fourth both Black. Fourth row — first Agouti, second Silver Fawn, third Black, fourth Champagne. Ratio is nine Agouti, three S/F, three Black, one Cham. 9:3:3:1 per sixteen babies.

So from a Cham/Agouti pairing, Black and Silver Fawn can be produced. This is the system needed to produce a Siamese with different points to a Seal Point, ie: Mink Point Siamese. For this you would require a Seal Point Siamese and a Self Mink.

Seal Point Siamese aa BB ChCh DD PP

Self Mink aa bb C C DD PP

As before, ignore all common loci.

The F1 ge' tions will all be of genotype Bb CCh which are Blacks, These are mated together, the paired ge' eing Bc, bC, BCh, bch.

	Bc	bC	Bch	bch
BC	BBCC	BbCC	BBCch	BbCch
bC	BbCC	bbCC	BbCch	bbCch
Bch	BBCch	BbCch	BBchch	BbChch
bch	BbCch	bbCch	BbChch	bbchh

Looking carefully you will see that the ratio is nine Black, three Siamese, three Mink and one Mink Siamese out of sixteen. If no mink Siamese are present in the first litter, try pairing one of the F1s with all the Minks in the litter. At least one is liable to be bbCch, giving combinations of cC and bch.

Ratio of 3 Blacks: 3 Minks:		BC	bC	Bch	bCh
1 Siamese: 1 Mink Siamese	bc	BbCC	bbCC	BbCch	bbChC
out of eight babies.	bch	BbCch	bbCch	Bbchch	bbchch

Working with 3 options — it's far too space consuming to go into this in great detail, suffice to say that the genes must be paired in threes, not twos, though the same chessboard method can be used.

VARIETIES AND WHAT CAN BE EXPECTED FROM PAIRING

Some idea of what a rat can carry follows, the more recessive the coat colour, the less it can carry.

AGOUTI

AA BB CC PP The Agouti is made up of dominant genes, all of which may be paired with an allele, eg: Aa Bb Cch Pp. This rat will appear the same as the 'pure' Agouti. If this rat is mated with a Black, a proportion (25%) of the litter will be Black. Therefore, from an Agouti, any colour can come.

BLACK

aa BB CC PP This has one recessive locus. If mated to another **non** Agouti, it will not produce Agoutis. Blacks can carry any non Agouti colour.

CINNAMON

In spite of confusion over their genetics it is known that Cinnamons can never produce any of the Black group animals, but they can carry other colours, especially Mink.

MINK

Mink can only really produce pale Champagne and dark Pearl.

PEARL

Pearl can produce Mink and pale Champagne.

SIAMESE

Siamese/Siamese produces only Siamese. This is a Black group animal and will produce Black or Agouti when paired with an unrelated colour. When paired with PEW it produces Himalayan.

HIMALAYAN

Himalayan/Himalayan matings produce Siamese, Himalayan and PEW. Otherwise it is the same as for Siamese.

PINK EYED WHITE (PEW)

It is important to remember that this variety can carry any colour/marking combination except Siamese, although in practise most are carrying Black Hooded. Mating two PEW together, however, yields only PEW.

SILVER FAWN

This is a Black group animal (BB) and is Pink Eyed Agouti. Show quality Silver Fawns are pink eyed Agouti Berkshires or Irish (possibly hi). Mated to a Black or Ruby eyed rat the litter will be all Agouti (assuming the Silver Fawn is pure bred).

CHAMPAGNE

This is a Pink eyed Black. If mated to a Dark eyed non Agouti, eg: Mink, it will produce Black.