

NOTES ON THE GENETIC BEHAVIOUR OF CERTAIN
CHARACTERS IN THE POLECAT, FERRET, AND
IN POLECAT-FERRET HYBRIDS.

By FRANCES PITT.

(With One Text-figure and Plates XV and XVI.)

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I. INTRODUCTION.

These notes deal with the genetic behaviour of colour and certain cranial characters in the ferret, *Martes furo* (Linnaeus), in the polecat *Mustela putorius* (Linnaeus), and in the hybrids obtained by crossing the two species. Unfortunately, owing to the difficulty of keeping a number of flesh-eating animals, which difficulty was much greater during the War, and since then to the loss of all my ferrets from distemper, my observations and results are very incomplete. They are only published

Spiraea ulmaria.

A variegated form has stems, petioles, and central parts of the leaflets devoid of chlorophyll (Pl. XIV, fig. 2), and of a whitish yellow colour. Ordinary green plants are perfectly fertile on both male and female sides, but this variegated plant is quite sterile, forming no seeds or pollen. A few ill-formed carpels have been found on it, but the seeds they contained were aborted and did not germinate. The condition is closely reminiscent of the zonal Pelargonium, "Freak of Nature," mentioned in *Jour. Gen.* 1919, VIII. p. 97, *note*, which has green borders to leaves and stipules and is totally sterile on both sides. The extraordinary feature of that plant is that the green, white, and green-over-white shoots which Freak of Nature often produces are perfectly fertile. The variegated *Spiraea* has not hitherto produced any shoots other than those described. From its roots it readily gives rise to adventitious buds, and all leaves borne by them are albino, quite destitute of chlorophyll, like the stalks and petioles.

In my previous article on root-cuttings I spoke of the dissimilar forms which arise as being in all probability included as "cores" within a cortex of the ostensible type. The whole plant is thus regarded as a periclinal chimaera, one variety enclosing another, and this enclosed form may be expected to come out whenever the plant makes an adventitious bud by endogenous growth. Though this view is presumably correct in most cases the distribution seen in the variegated *Spiraea* and Freak of Nature show that other possibilities must be remembered. For in these plants the white tissue is not covered in, but extends through the whole of the internodes, and doubtless the root also. The growing point alone carries up with it the power of making green tissue. In such plants as the *Bouvardia* or Pelargoniums which give dissimilar root-cuttings the two kinds of tissue are not recognizably distinct in the plant until they flower, and though perhaps unlikely, it is not impossible that the kind which arises by adventitious buds may really provide the *whole* of the root and perhaps the internodal regions. Many herbaceous variegated plants arranged periclinally are liable to give shoots composed entirely of either their external or their internal constituents. Such shoots with special frequency arise near the base of the plant, i.e. just above the level at which the stem was divided in propagation. Though their mode of origin is not always easy to decide, it must be supposed that they are generally produced by adventitious buds. These evidently are not always

endogenous but may be originated by a periclinal division in the cortical layer.

In such an example as the crumpled zonal here described, or indeed in any periclinal chimaera with patches of its core coming out on the surface of leaves, the process by which this change is brought about is very difficult to imagine and I do not know how it may be represented. The growing point must contain both elements, but the emergence of that which is normally enclosed seems at present to be purely fortuitous.

As regards *reversals* of the layers, such as I described in *Jour. Gen.* VIII. 1919, p. 94, it is worth observing that though we have now fairly numerous cases of white-over-green turning to green-over-white, a change which in some plants happens frequently, we have not hitherto seen a single instance of the contrary. Of *Euonymus*, some zonals, an ivy-leaved Pelargonium, and *Arabis* we have several large and well-grown plants of the green-over-white kinds, but though occasionally the white has come to the surface in a small area, no reversal has been found on such plants. Possibly we may regard white-over-green as an arrangement mechanically less stable than green-over-white.

Several attempts have been made to breed the root-cuttings with their parent plants, an experiment offering attractive possibilities, but we have hitherto been unsuccessful.

EXPLANATION OF PLATES.

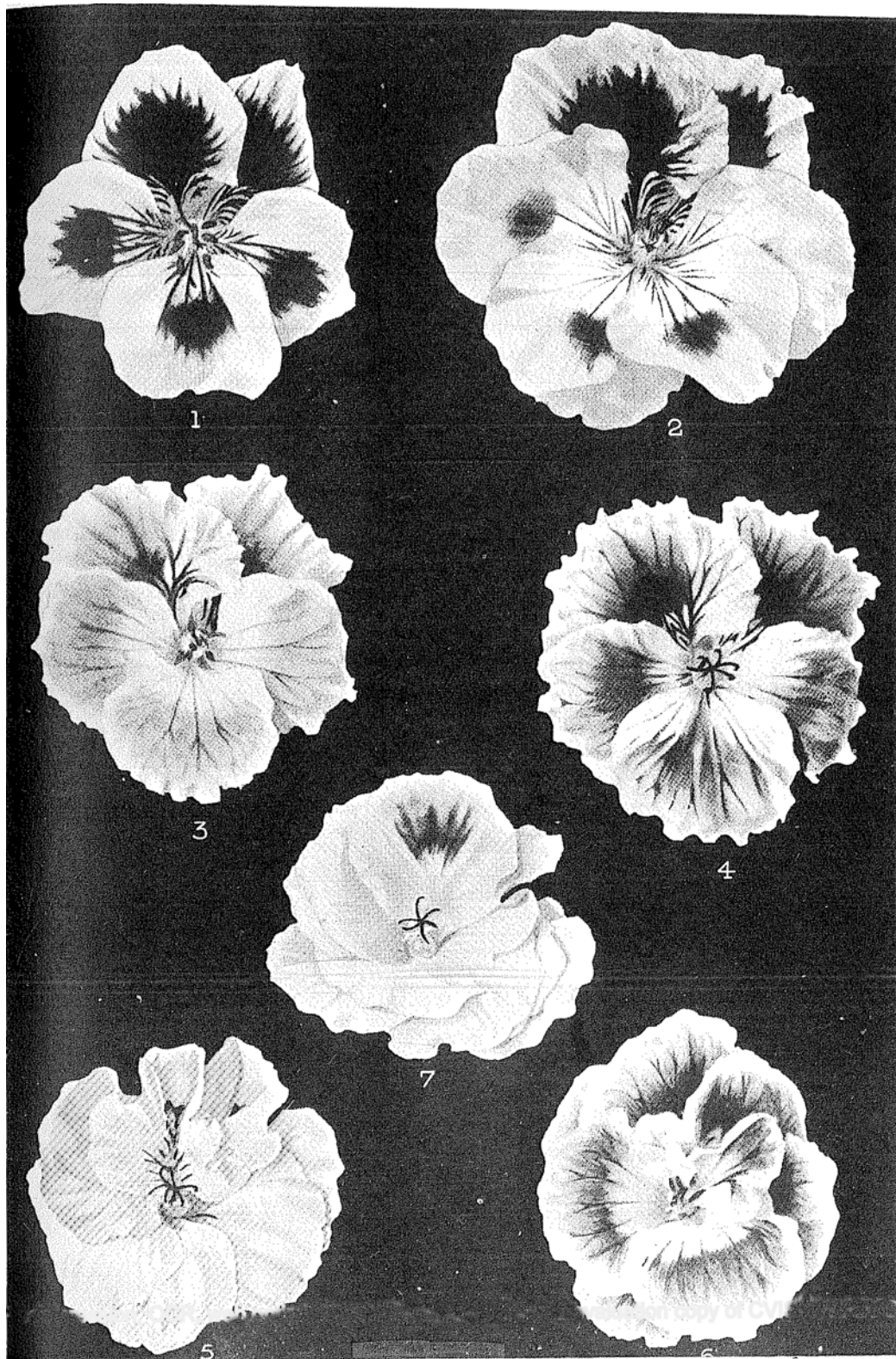
PLATE XIII.

- Fig. 1. Pelargonium Escot.
- Fig. 2. Root Cutting of Escot.
- Fig. 3. Pelargonium Mrs Gordon.
- Fig. 4. Root Cutting of Mrs Gordon.
- Fig. 5. Pelargonium Pearl.
- Fig. 6. Root Cutting of Pearl.
- Fig. 7. Flower with red blotch, a form occasionally seen on Pearl.

This plate is from drawings by Mr C. H. Osterstock. In the photograph the colours of Escot and the two forms of Mrs Gordon are approximately correct. In Escot's root-cutting the red should be distinctly brighter, without any bluish tinge, and the same applies to the red colour in figures 6 and 7.

PLATE XIV.

- Fig. 1. Zonal Pelargonium Golden Flame. On the right is seen the foliage of the type, which is buckled and shiny. On the left the sport, with leaves flat and dull. The two right-hand inflorescences are lacinated. The two left-hand inflorescences bear mixed flowers, some entire, some lacinated. The fruits formed in two entire flowers are visible. These mixed inflorescences belonged to the area of transition.
- Fig. 2. *Spiraea ulmaria*: leaf of variegated form.
- Fig. 3. ditto leaf of normal green form.



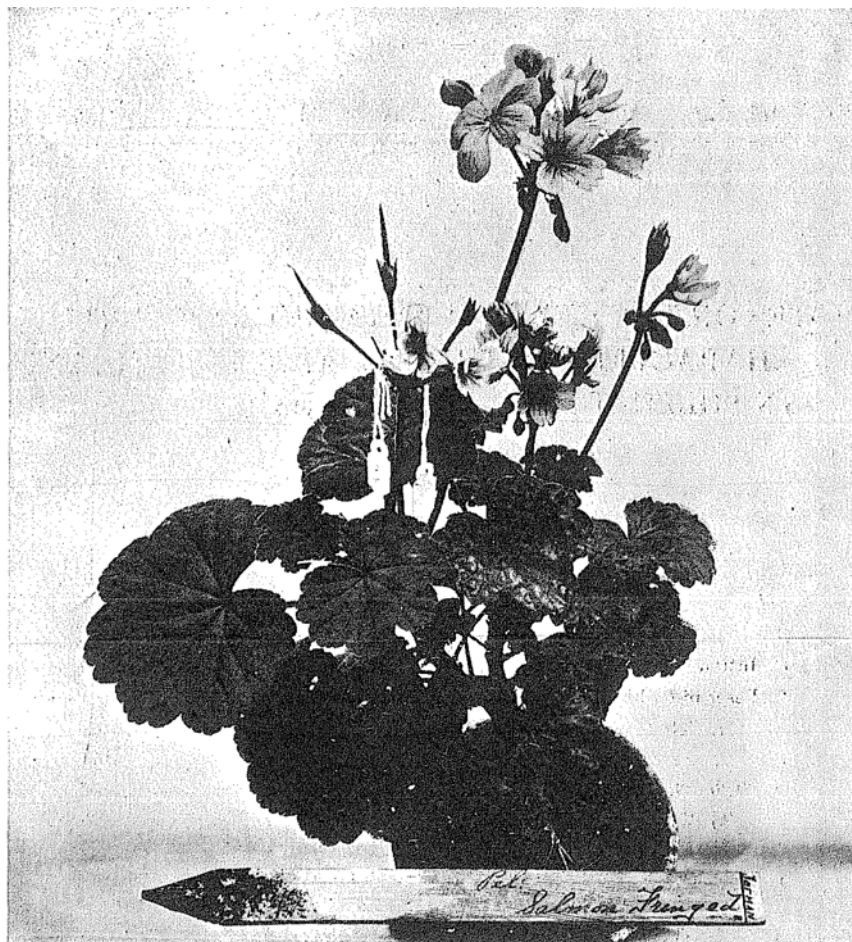


Fig. 1.

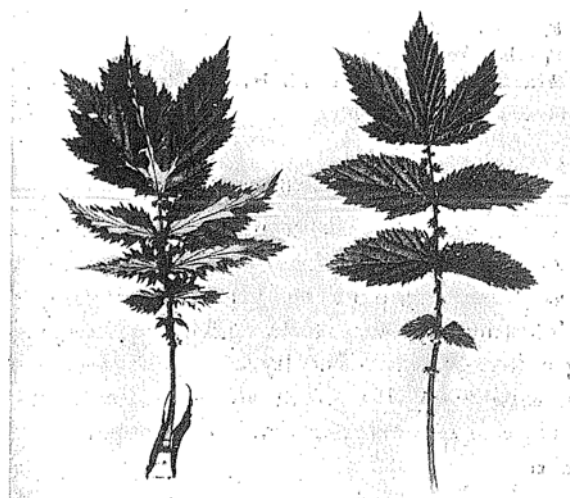


Fig. 2.

Fig. 3.

Skull measurements to show comparative sizes in the Polecat, Ferret, and their Hybrids.

Number	Sex	(Cranial length)	Zygomatic breadth	Mastoid breadth	Interorbital breadth	Rostral breadth over canines	Depth of brain-case	Palatal depth behind tooth-rows	Mandible	Maxillary tooth-row	Mandibular tooth-row	Post-orbital breadth	Observations	Locality
No. XVI coll. F. P. ...	♂	67.0	42.0	35.5	19.0	17.5	18.0	20.0	43.0	20.0	25.0	13.0	Teeth very worn	—
No. 13 ...	♀	58.0	35.5	32.0	16.0	14.0	16.0	16.0	36.5	19.0	23.0	13.5	Teeth slightly worn	—
No. 28 ...	♀	59.0	33.0	30.0	15.0	13.0	16.0	16.0	35.0	16.0	20.0	14.0	Teeth not worn—18 months old	—
No. 14 ...	♀	55.0	32.0	29.0	14.0	13.5	15.0	15.0	33.0	16.0	18.0	13.0	”	—
No. LV coll. F. P. ...	♂	67.0	40.0	35.5	19.0	17.5	20.0	20.0	42.0	20.0	24.0	18.0	Teeth slightly worn	Nr Aberystwyth, Cardiganshire
No. LIII ...	♂	70.0	42.0	38.0	19.0	17.0	20.0	20.0	42.0	20.0	24.5	18.0	Teeth worn	Tregaron Bog, Cardiganshire
Br. Mus. 39. 7. 15. 3	♂	66.0	40.4	37.0	17.8	16.0	20.0	18.4	40.0	19.0	23.4	—	Teeth moderately worn	No exact locality
Brit. Mus. O. 10. 9. 1	♂	66.8	41.4	36.8	18.0	17.4	19.6	18.0	42.6	19.4	24.0	—	”	Nr Aberystwyth, Cardiganshire
No. XVIII coll. F. P.	♀	61.0	35.0	33.0	17.0	15.0	17.0	18.0	37.0	18.0	22.5	16.0	Teeth worn	Nr Aberystwyth, Cardiganshire
Br. Mus. 39. 7. 15. 2	♀	62.4	38.0	35.2	16.8	15.0	18.4	17.0	37.0	17.8	21.4	—	Teeth slightly worn	England, no exact locality
U.S.A. Nat. Mus. 791	♀	—	32.2	30.0	14.4	14.0	17.6	15.4	34.4	17.0	21.0	—	”	”
U.S.A. Nat. Mus. 792	♀	61.2	35.0	31.8	14.2	13.2	17.0	16.8	37.2	18.2	21.4	—	”	”
No. 35 ...	♂	64.0	39.0	35.0	17.0	16.0	18.0	18.0	40.0	20.0	23.0	13.0	Teeth very worn	—
No. 29	♀	56.0	33.0	30.0	15.0	13.0	15.0	16.0	33.0	16.0	20.0	13.0	18 months old	—
osset & Ferret	♀	54.0	33.0	29.0	14.0	12.5	14.0	15.0	32.0	16.0	20.0	12.0	3½ years old, very worn teeth	—
No. 28	♀	59.0	33.0	30.0	15.0	13.0	16.0	16.0	35.0	16.0	20.0	14.0	18 months old	—
No. 38	♀	55.0	32.0	29.0	14.0	13.5	15.0	15.0	33.0	16.0	18.0	13.0	”	—
No. 26	♂	60.0	38.0	33.0	17.0	14.0	18.0	18.0	37.5	18.0	24.0	15.0	Teeth worn	—
rosset with the Polecat	♂	50.0	28.0	26.0	15.0	13.0	18.0	16.0	31.0	17.0	20.0	16.0	Less than half grown—milk teeth still in position	—
No. 46	♀	56.0	33.5	29.5	15.0	13.0	17.0	15.0	34.0	17.0	21.0	13.5	Teeth slightly worn	—

The Roman numerals refer to the numbers of specimens in my collection, and the Arabic to the reference figures used in my experiments. The Brit. Mus. and U.S.A. Nat. Mus. measurements are those given by Miller in his *Catalogue of the Mammals of Western Europe*.

because I am not aware of any work done on these species, and the notes may draw the attention of other workers to an interesting subject for research.

II. DESCRIPTION OF THE POLECAT AND THE FERRET:

(a) *The Polecat, M. putorius*, resembles the domestic ferret in build and general appearance. The males generally exceed 400 mm. in length (head and body), the females being smaller and averaging but 350 mm. Its most obvious superficial characteristic is its deep blackish brown colouring that has almost a plum tint, and which is much darker than the hue of the deepest of so-called "polecat" ferrets. The colour deepens into black on the underparts and extremities. The coat consists of two kinds of fur, a thick drab or yellowish wool next the skin, and a longer covering of coarse shining black hairs, which repel rain and damp. The exact hue of the animal differs according to the season and the proportions in which the two kinds of fur are present. In the winter, when the woollen under-fur is thickest and longest, the polecat appears lighter than after the summer moult. It often appears larger than its true size owing to its habit, when frightened or annoyed, of erecting its fur and fluffing out its thick tail. At the same time it makes a hissing noise, and if this attempt at intimidation fails ejects from its anal glands a most evil-smelling fluid. How disgusting an odour it is only those who have smelt it can appreciate! The polecat is highly nervous in disposition and I have never succeeded in taming one caught adult. In shape the polecat is not so light or elegant as the ferret, being somewhat more heavily built. Its head is decidedly blunter in both sexes, and, when viewed from above, forms roughly an equilateral triangle. The muzzle, tips of the ears, and a small patch of fur over each eye, are greyish white. The latter patches sometimes join to form a pale band across the face, but this is never so pronounced as in the dark form of the ferret (see Pl. XV, figs. 2 and 3). The skull is strongly built, but not more so than in the ferret, from which, however, it differs in several particulars, namely in the more flattened triangular bullae, the greater breadth of the post-orbital region, which in this species averages 18 mm. in the male, and the larger size of the carnassial teeth. Furthermore, in such polecat skulls as I have been able to examine, the ridges extending from the post-orbital processes to the sagittal crest form a much longer and more acute angle than they do in ferret skulls (see Diagram I, figs. 1 and 2). But I must add that Miller (3) figures a polecat skull with ridges forming as blunt an angle as that of any ferret's skull. The polecat ranges through Europe eastward,

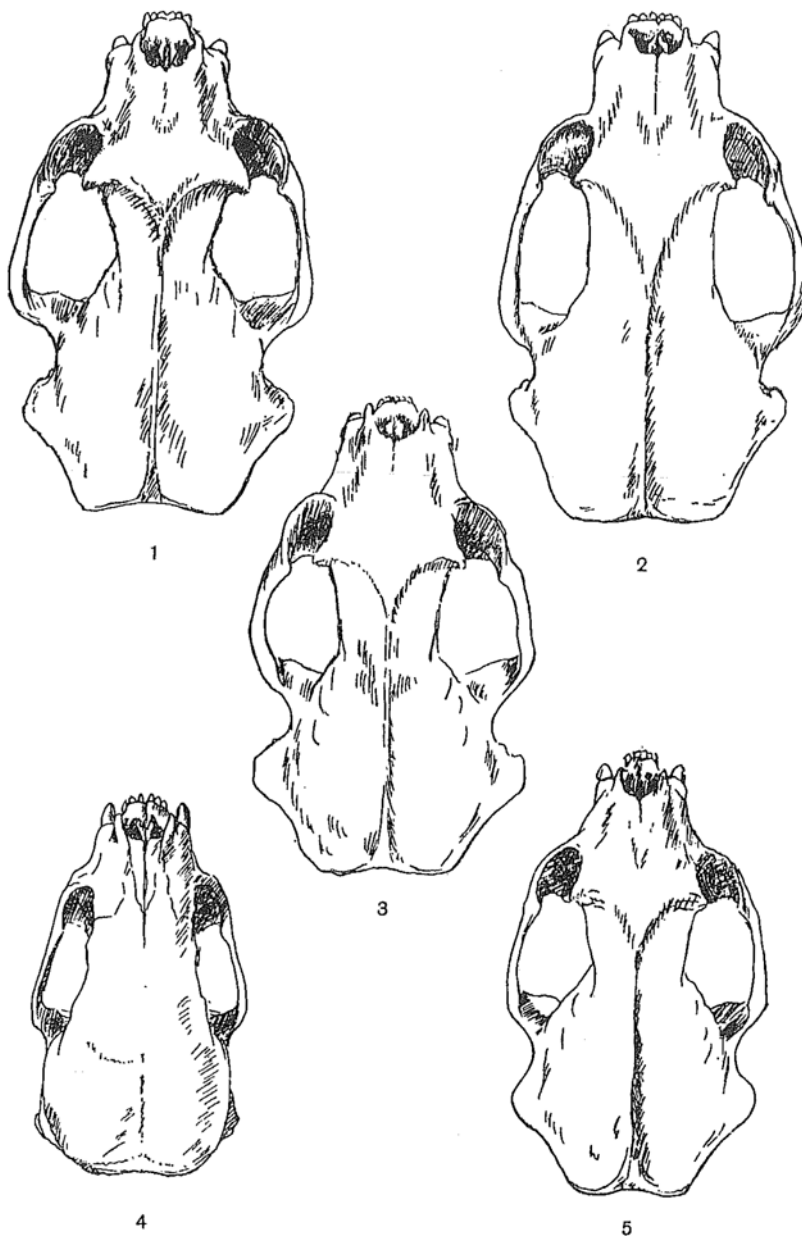


Diagram I.

1. Ferret skull, adult ♂.
2. Polecat skull, adult ♂.
3. Skull of an F_1 individual, adult ♂ No. 10.
4. Skull of No. 45, immature ♂, the produce of an $F_1 \times$ Polecat mating.
5. Skull of No. 19, adult ♀, the produce of an $F_1 \times$ Ferret mating.

and from the Mediterranean north to Scandinavia, with practically no variation, Miller describing but one doubtful subspecies from Spain, the distinguishing character of which being its more golden under-fur. In Britain the polecat is now rare, and is practically confined to central Wales. Any specimens found outside that area should be viewed with the gravest suspicion, generally proving to be merely escaped ferrets of a dark colour. The species still exists in some numbers in Cardiganshire, but how long it will be able to hold its own in the face of steady persecution is another matter.

Measurements of Polecats and Ferrets.

Number of Specimen	Sex	H. and B.	TL	Ear	H. F.	Remarks
<i>Typical dark form of the Polecat :</i>						
XVIII coll. F. P.	♀	350 mm.	127 mm.	20 mm.	56 mm.	Cardiganshire
LIII " "	♂	455 mm.	165 mm.	25 mm.	65 mm.	"
*Coll. Brit. Mus. N. H.	♂	403 mm.	163 mm.	27 mm.	61 mm.	"
" " "	♂	415 mm.	190 mm.	30 mm.	62 mm.	"
" " "	♀	360 mm.	140 mm.	23 mm.	53 mm.	"
<i>Erythristic variety of the Polecat :</i>						
LIV coll. F. P.	♂	450 mm.	150 mm.	21 mm.	58 mm.	"
(the above measurements are not absolutely reliable, being taken from a specimen that had been set up)						
<i>Albino Ferret :</i>						
15	♂	358 mm.	126 mm.	18 mm.	50 mm.	—
32	♂	375 mm.	137 mm.	20 mm.	54 mm.	—
33	♀	312 mm.	112 mm.	16 mm.	54 mm.	—
<i>Dark Ferret :</i>						
29	♀	371 mm.	118 mm.	21 mm.	51 mm.	—
19	♀	312 mm.	117 mm.	20 mm.	49 mm.	—
<i>Erythristic Ferret :</i>						
20	♀	340 mm.	130 mm.	21 mm.	53 mm.	—
28	♀	350 mm.	117 mm.	20 mm.	49 mm.	—
<i>Hybrid Ferret-Polecat :</i>						
10	♂	370 mm.	131 mm.	22 mm.	59 mm.	—
<i>Hybrid × Polecat produce :</i>						
45	♂	237 mm.	68 mm.	20 mm.	42 mm.	Died young
46	♀	340 mm.	110 mm.	20 mm.	47 mm.	—

The Roman numerals refer to the numbers of specimens in my collection, and the Arabic to the reference figures used in my experiments.

All the measurements given above were taken after death, it being found impossible to measure a live animal satisfactorily, for which reason many of those bred were never measured at all.

* From Miller's *Catalogue of the Mammals of Western Europe.*

(b) *Description of the Ferret.* It has been long assumed that *M. furo* is a domesticated form of the polecat, which it so much resembles in general build and character, the fact that the majority of ferrets are pink-eyed cream-coated albinos being considered confirmatory rather than contradictory of the idea, especially as pigmented individuals resemble polecats in their colouring and facial markings. That is to say they resemble them in their general type of marking, but not exactly, as all "fitchet"¹ ferrets I have seen have been much lighter in hue than the palest of polecats, showing, too, broader facial markings, so that there is a marked reduction of pigment compared with the wild animal. Not only are the white facial markings so much increased, but the woolly underfur, which in the polecat is invariably a buffy-drab colour, is whitish in the dark ferret. The "fitchet" ferret bears in outward appearance the same relation to the polecat that a half-printed photograph bears to the fully printed one from the same negative. The head of the ferret is narrower than that of the polecat, appearing when seen from above as an isosceles triangle, whereas the face of the polecat makes an equilateral triangle². As regards size the average ferret is a trifle smaller than the average polecat, it being a large male which exceeds 380 mm. head and body measurement. The appended table shows the respective measurements. In cranial characters we come to some important differences between the two forms, which differences have made Miller (3) express the opinion that, "the ferret, *Martes furo* Linnaeus, though usually assumed to be a domesticated variety of *Mustela putorius*, appears to be more nearly related to the Asiatic *M. eversmanni* Lesson." The differing points in the ferret's skull are: the more narrow constricted post-orbital region, averaging in the male only 13 mm. in breadth, against the 18 mm. of the male polecat, which gives the skull a "small-waisted" appearance; the more inflated and less triangular auditory bullae; and the smaller carnassial teeth. The only skull of *M. eversmanni* that I have been able to examine showed a marked likeness to the ferret's in all the above characters, but every ferret's skull I have seen has differed in one respect from both the single specimen of *M. eversmanni*, and from every polecat's that I have met with, this character being the shortness of the ridges that proceed from the post-orbital processes towards the brain-case, and which converge at a much blunter angle than they do in the polecat. The length in seven

¹ "Fitchet" is a term commonly employed by keepers, rabbit-catchers, etc., to denote the dark or so-called "polecat" ferrets. I have avoided herein the use of the latter word for fear of misunderstanding.

² Mr A. H. Cocks first drew attention to this in the *Zoologist*, Vol. xv, 1891, p. 344.

ferret skulls averaged 14 mm., against 21 mm. in three polecats. In the *M. eversmanni* skull that I examined the ridges were as long as those of the European polecat and noticeably different from those in *M. furo*. This seems to indicate a character in the ferret that is not possessed by either of the other species. In such intangible peculiarities as temperament and disposition the ferret is very different from *M. putorius*, as is shown by the ease with which it is tamed even after being neglected while young. An adult-caught polecat is quite untameable, and even half-bred ones require constant handling from their earliest youth to make them docile. It takes a very serious fright to make a placid easy-going ferret emit the vile defensive odour, but the hybrids never hesitate to make use of it. In disease-resistance too the ferret differs from the polecat, being less susceptible than the wild animal to some of the diseases met with in captivity. For instance the majority of polecats exhibited at the Zoological Gardens, Regent's Park, succumb more or less speedily to pneumonia, and I have found the hybrids nearly as delicate. In the case of epidemic diseases, such as one of the complaints that get classed under the heading of "distemper," polecat-bred ferrets have in my experience been always the first to take it, and with more fatal results than those of pure ferret descent. For instance I recently lost six ferrets in the following order: first No. 19, a dark female the offspring of a hybrid and an albino; secondly another dark female, No. 29, whose sire carried polecat blood; then a fawn ferret, No. 28, full sister to the preceding; and lastly three white ones. The latter were not only the last to take the disease, but did not succumb nearly so quickly.

From the foregoing it will be seen that there are quite a number of points of difference between the polecat and ferret, both structural, pigmental, physiological, and temperamental, so that the grounds for doubt as to whether the one is derived from the other are quite substantial, and the materials are such as to afford a most interesting subject for genetical investigation.

III. VARIATION IN THE POLECAT AND IN THE FERRET.

(a) *Variation in the Polecat.* It is noteworthy when considering the relationship of the polecat and ferret, that, as far as I can ascertain, no albino polecat has been recorded. Nevertheless it is probable such sports do occur, for unless the specimen passed into the hands of an expert and was examined as to structural details, it would almost certainly be dubbed a feral ferret. The probability is enhanced when we find that

erythristic mutations are known. In this variety the black pigment is entirely suppressed, leaving the animal a beautiful reddish colour. Erythrism is usually regarded as partial albinism, and in many species is accompanied by absence of pigment from the eyes, but in the "red" polecat the eyes are dark. The following is a good description of this mutation. "The colour may be described roughly as: under fur light buff, the longer hairy coat being a reddish-brown. When seen in sunlight the latter shows a kind of faint purple 'haze,' it is difficult to describe it otherwise." The writer, Mr F. S. Wright (4), adds that in all the specimens examined by him the facial markings were normal, "but owing to the lighter ground colour of the animal the contrast was naturally not so great as in the common dark polecat"¹. I can confirm this from my own observation.

Light brown polecats are only known from Cardiganshire, and chiefly from the district around Aberystwyth, the greater number being recorded from the neighbourhoods of Borth and Tregaron bogs. The first specimens were made known in 1902-03 (2), since when more than a dozen have been killed. From this it seems that the form has originated comparatively recently in the locality mentioned, and that the mutation (for we may safely assume it to be due to the loss of the black pigment factor) far from tending to disappear is even on the increase. As all the red polecats that have so far been recorded have been met with on the Costal Plateau of Cardiganshire, an area which extends from the River Dovey to Tregaron—about eighteen miles apart—it is evident that the area, wherein we must seek the point of origination, is a comparatively restricted one. As the first specimens were killed on Tregaron Bog it is possible that this is the locality. As would be expected in the case of a variation originating from the loss of a factor the reddish-brown colouring gives us an example of simple Mendelian inheritance. The case is somewhat interesting however, as it is not very often that we get evidence of the action of Mendel's law in wild Nature. Even in this case the information is but scanty. In July, 1915, two young polecats of the same litter, the one normal in colour, and the other red, were killed on Borth Bog, "It is noteworthy that in the two offspring the colours show no intermingling whatever" (4). Unfortunately there is no evidence to show whether the light brown type is dominant or recessive, but judging by a similar fawn-coloured variety of the ferret, presently to be described,

¹ Mr H. E. Forrest (2) has stated that the facial markings are sometimes suppressed in this variety, but he now tells me (*in litt.* Feb. 16, 1920) that he is confident it was an error due to the lessened conspicuousness of these markings on a light brown ground.

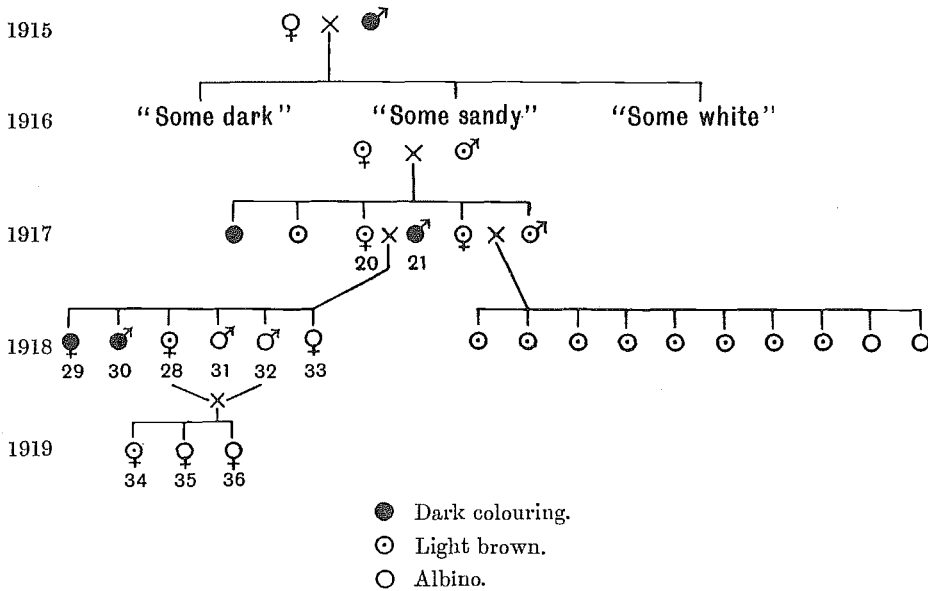
and by analogy with the behaviour of similar pigmentary characters in other species it is probably the latter. If we are right in supposing that the red coloration is due to the absence of the factor for black, it becomes at once apparent that it would be a most difficult task to decide how and when the factor first fell out. The tendency to the red coloration might lie latent for many generations until a suitable mating brought together gametes from both of which the factor was missing. It must be remembered that the dark offspring of a red \times dark mating would necessarily be heterozygotes, of the constitution $DBdB$ (I am herein using the letter " D " to indicate the dark black-brown colour, " B " the light red-brown, " db " the absence of all pigment or albinism), and if such heterozygotes are fairly widely distributed it would account for the sporadic way in which the red-brown individuals have turned up during the last seventeen or eighteen years since the first specimens were obtained. It is evident that in this variety of the polecat we have not really anything new, for the factors for it have undoubtedly been latent in the animal's constitution since it assumed its present type of coat and colouring.

(b) *Variation in the Ferret.* We may confidently assume that in the pigmented and so-called "polecat" ferret (known among keepers and rabbit-catchers as the "fitchet") we have a near approach to the ancestral type, from which the well-known white form is almost certainly an albinistic mutation. Erythristic ferrets analogous to the reddish-brown polecats are also met with, but, as the "fitchet" ferret is paler than the dark brown-black wild polecat, so is the fawn ferret paler than the "red" polecat, being much more "washed-out" looking. It is evident that we here meet with similar if not identical pigmentary characters to those found in the polecat, therefore the same letters may be used to denote the factors, D for dark black-brown or full pigmentation, B for light red-brown, and so on.

A detailed account of the behaviour of the black-brown pigmentary character will be given later on under the heading *Ferret-Polecat Hybrids*, and I will now confine myself to the erythristic variety. The exact tint of the fur is best described by the word "sandy." The colour is confined to the long outer hairs, the woolly undercoat being white. As in the red-brown polecat the absence of black pigment is correlated with size and vigour. Most of the sandy ferrets I have seen have been exceptionally fine animals. They are also noticeably quicker tempered than dark or white ones. It is my experience that they require a good deal more handling to keep them quiet and docile, and even then cannot be trusted. One sandy ferret I had was called "Ginger" on account of

her liability to snap. Other persons have expressed the same opinion to me. In connection with this it must be remembered that red-headed people are notoriously sharp tempered, and chestnut horses are often very "hot." Erythristic ferrets are not very common, but I have met with the variation in four distinct strains. The individuals that belonged to me originated from a mating between "a white female and a very large dark male...they had some dark, some white, and some sandy young ones¹." As there were several sandy young ones we may be certain that one parent, presumably the dark, was heterozygous for the red character, and that for the origin of the mutation we must go further generations back, because if the factor had fallen out at this particular mating only

Pedigree of Light Brown Ferrets.



The numbers refer to animals bred by me, and serve to identify the same individuals in different pedigrees.

one of the family could have borne the new character. When the erythristic ferrets obtained in this litter were bred from, the owner tells me, a litter of four "reds" and *one dark* resulted, which, provided no error occurred, shows that the factor for full pigmentation may be borne in a latent state by the red individuals. However the dark colouring is

¹ For this and other information I am indebted to Mr Wm. Milner, of Much Wenlock, who most kindly gave me some of his erythristic ferrets.

usually dominant to its absence, as will presently be shown when the evidence concerning the hybrids between the ferret and polecat is given. It is probable that in fawn and in "fitchet" ferrets we meet with dilution factors that complicate matters, but the numbers so far bred are too small for the facts to be elucidated. The various matings of which I have records in which fawn-coloured ferrets have been involved are tabulated below. It will be seen that in a cross of red \times dark the white class was larger and the red smaller than expected.

Tabulated results obtained from matings of erythristic ferrets:

		Dark	:	Fawn	:	Albino
Fawn \times fawn	...	1	:	4	:	0
		0	:	8	:	2
Totals		1	:	12	:	2
Fawn \times dark	...	2	:	1	:	3
Fawn \times white	...	0	:	1	:	2

IV. FERRET-POLECAT HYBRIDS.

(a) As the characters in which the polecat and the ferret differ have already been described, it is unnecessary to go over them again; I will only remind the reader that they consist of certain cranial peculiarities and of coat colour. There is also considerable difference in temperament, the domestic animal being placid and easy-going, the wild one very much the reverse.

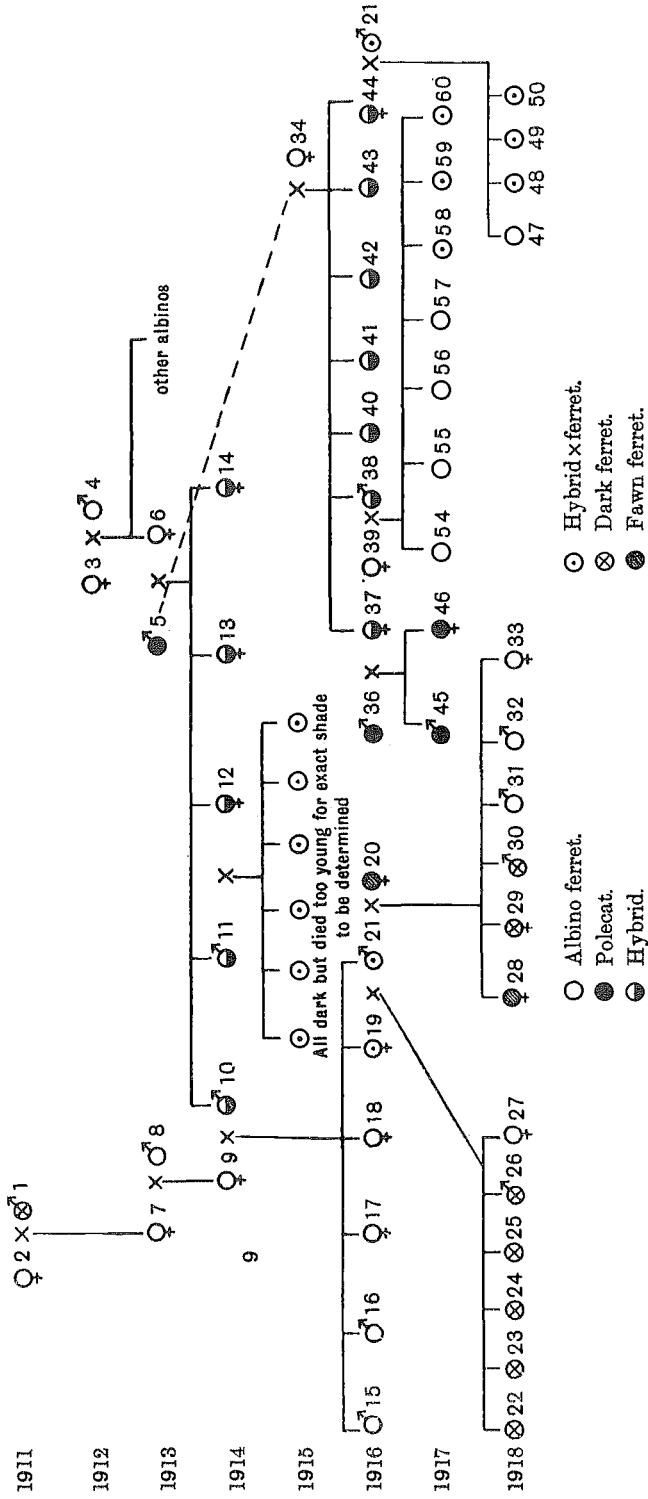
(b) In 1912 I was fortunate in obtaining a very fine male polecat from Cardiganshire, also a female, but as she never bred she is only mentioned here because she served as a standard with which to compare the female hybrids that were subsequently reared. The male, No. 5 in the accompanying pedigree (p. 111), was mated with an albino ferret of known pure white ancestry for several generations. The resulting litter numbered five, two males and three females, all dark in colour, and showing complete dominance of the wild type in the F_1 generation. Perhaps the words "complete dominance" need qualification, for, notwithstanding the hybrids were much darker than any so-called polecat ferret, they did show slight traces of the ferret side of their ancestry, inasmuch they had whitish under-fur instead of the buffy-grey wool of the true polecat. Nevertheless they were very dark in colour, the black-brown of the long hairs having the slight purplish sheen so characteristic of the polecat. The polecat temperament too was fully apparent, for, despite the fact they were made great pets of, and were constantly handled, they were

far more nervous than ordinary ferrets. They were easily frightened, and when startled would emit the horrible odour from the anal glands that constitutes one of the defences of the polecat. I have only known a ferret do this under stress of great fear and excitement—e.g. when pounced upon by a terrier in mistake for a rat! They also hissed at the least thing. They were far quicker and had more vitality than ordinary ferrets, romping and dancing together in the most delightful manner. When used for rabbiting they proved almost too quick, for it was quite difficult to pick up the nimble females as they darted in and out of the holes. They were deadly workers, killing their rabbits in a few seconds by biting them over the eyes, but never behind the ears after the manner of a stoat. A male (No. 10) was a good ratter, and I have seen him chase a rat that had bolted in the open. He was a great pet but had some undesirable traits in his character, his genius for escaping from all descriptions of cages being extraordinary. He would bite and tear his way through wire netting in a very short time, an ordinary wooden cage never kept him at home for long, and the only place where he was really safe was a loose-box with a strong well-fitting door. In his old age he climbed over a four foot pig-sty wall, made his way into a fowl-house, and therein slew six cockerells. When he died at four years old his teeth were the worn stumps of a very old animal. It then also transpired that though so polecat-like in appearance and behaviour his skull was that of a typical ferret. When placed side by side with the skull of a ferret of pure ferret ancestry it resembled it in all respects, being distinguishable at a glance from that of a polecat. Here we have an interesting case of the colour and temperament of one parent, and the cranial characters of the other, being dominant in the F_1 generation.

(c) *Notes on the Development of the Young Hybrids.* Before going on to another litter of hybrids it may be worth while to give details of the growth and development of the first family. They were born on June 26th, 1912, and on July 10th two crawled out of the nest, being then covered with milk-white hair¹, so short that their greyish-blue skin showed through it. Their mother dragged them back into the nest at once. At 17 days old they had grown a great deal, were darker, and had traces of the typical polecat facial markings. At 24 days old they were much browner, but with yet a mane of "skim-milk" coloured hair down the neck. The largest males' eyes had begun to open, and they were all

¹ Young ferrets, whether dark or albinos, and likewise young polecats, have a white baby coat. They are born naked, but quickly grow a scanty covering of milk-white hair, which as described above then gives place to the dark fur.

Diagram of the Inheritance of Colour in Ferret x Polecat Crosses.



112 *Polecat, Ferret, and Polecat-Ferret Hybrids*

trying to eat rabbit meat. The 25th day found two able to see a little, and all making vigorous efforts to eat. By the 36th day they were quite dark in colour, with white tips to their ears, white muzzles, but the light patches on the sides of the face as yet shadowy and indistinct. At seven weeks old they were perfect little polecats as far as outward appearance went, and it was not until they had gained their winter pelage that some slight trace of the ferret side of their pedigree could be discerned.

(d) *A Second Litter of Hybrids.* In 1916 the male polecat No. 5 was mated with another white female ferret (No. 34). She had by him a family of eight, all dark, but being a bad mother only reared three. These were in all respects exactly like the first hybrids, being quite as polecatlike in appearance, and even more nervous, for they did not get so much handling and petting.

(e) *Reciprocal Cross.* The reciprocal cross could not be made, as the female polecat which I had obtained after so much trouble never bred; but as albinism is invariably recessive to full pigmentation, we may be fairly confident that the result would have been the same.

(f) *F₂ Generation.* Owing to one mishap and another no F₂ litter was reared to maturity. The F₁-females that I kept to breed from caught distemper and died, but a male and female that I had given to Mr Riley Fortune did well until just before their young were born. The female then escaped from her cage, found a hole under the greenhouse floor, and there made a nest, in which her family was born. Mr Fortune kindly sent me full particulars of the progress of the litter, but misfortune was again in store, and the mother getting away was lost before her young ones could see. When deserted they were a whitish colour. As the young of all ferrets, whatever their ultimate colour is to be, have a white baby coat, this is no indication as to what they would have been like when adult. But one thing was proved, namely that the hybrids are perfectly fertile *inter se*.

(g) *F₁ Generation × the Ferret.* A mating between a F₁ male and a white ferret (Nos. 9 and 10) gave four albinos to two dark young ones. These latter were not so dark as their sire, and approached the ordinary fitchet ferret type. Another mating of an F₁ male with an albino female (Nos. 38 and 39) gave four whites to three darks. The total for the two litters was eight to five, whereas expectation was equality, but the numbers are too small for one to be able to arrive at any conclusions. When an F₁ female, No. 44, was mated with a male bred from the

F_1 × albino ferret cross (No. 21), which was polecat coloured, and therefore presumably heterozygous in constitution, three dark and one white young resulted (Nos. 47 to 50)¹. When two second-cross ferrets, Nos. 19 and 21 (i.e. the produce of the F_1 generation × albino ferrets), were bred together they had five dark young ones to one white. A mating of interest was that which has already been referred to between Nos. 20 and 21. The former was an erythristic female, the latter a dark male, the produce of a hybrid × a white ferret. The alliance between Nos. 20 and 21 gave rise to two dark, one red, and three white ferrets. As regards cranial characters, all skulls that I have been able to examine of these hybrid × ferret crosses have been indistinguishable in every particular from those of pure-bred ferrets. Full details and measurements of these skulls will be found in the table on p. 100.

(h) F_1 Generation × the Polecat. In 1916 I was fortunate in obtaining another fine male polecat from Cardiganshire. He was mated with No. 37, an F_1 female by my first polecat. Her litter only numbered two. These two youngsters appeared true polecats in every respect, having the broad faces, dark coats, drab under-fur, and highly nervous dispositions of the wild animal. I subsequently found that in cranial characters too they were polecats, for their skulls were typical of *M. putorius*. The male died young, but the female lived to be eighteen months old, when she too unfortunately succumbed to pneumonia without having bred. This susceptibility to pneumonia is a characteristic of the wild animal, most captive polecats sooner or later dying of it. Pure-bred ferrets appear to be much more resistant to the disease. In temperament and disposition this young female was quite the wild animal, she was intensely nervous, bit whenever she got the opportunity, and in her excitement was always ready to emit the horrible polecat smell; in short there was no trace of the ferret about her.

(i) *Weakening of Pigmentation in Hybrid × Ferret Crosses.* Before glancing back over the evidence that has been presented concerning polecat × ferret hybrids, it may be as well to draw attention to the weakening of pigmentation that occurs when the polecat-ferret hybrids are bred back to the ferret, the three-fourths ferret offspring being much paler than the first cross. These individuals are very like the ordinary "fitchet" ferret, but still further dilution takes place when another back cross is made. After this the pigmented individuals are very "washy"

¹ For information concerning this litter I am indebted to Mr Owen of Oswestry into whose possession the parents had passed.

in appearance and exactly like the average dark ferret. Whether there is a true dilution factor involved appears doubtful, the lighter appearance of the animal being due to a smaller quantity of dark hairs in its coat, not to reduction of the pigment in the hair, as in "dilute" mice, rats, and rabbits. Were true dilute ferrets to occur I should expect them to be a pearl-grey colour. In "fitchet" ferrets the lighter colouring, lighter than is by comparison with polecats and their hybrids, is due to the white or pale cream under-fur, to the cream basal portion of the longer hairs, and to the general increase of cream coloured fur.

V. RECAPITULATION AND CONCLUSION.

Attention has been drawn in this paper to the interesting material for genetic study that is to be found in the polecat and ferret, the two forms have been described, together with their points of difference and resemblance, and it has been shown that the characters in which they differ are such diversified ones as coat colour, cranial peculiarities, and temperament. The doubt as to whether the ferret is a descendant of the European or Asiatic polecats has been alluded to, and evidence has been given that it at any rate will cross freely with *M. putorius*, the hybrids being fertile *inter se*, and with either parent. The F_1 generation shows complete, or very nearly complete, dominance of the polecat type as regards outward appearance, but what evidence is to hand indicates that in cranial characters the ferret is dominant. When the hybrids were bred back to the ferret the polecat coloration and temperament were soon lost. Likewise when the hybrids were bred back to the polecat, animals that were apparently pure polecats resulted. An interesting result of the back crosses with ferrets (albinos) was the gradual weakening of the colour in the pigmented offspring, due not to dilution of the pigment in the hairs, but to a reduction in the amount of dark fur. Attention has also been drawn in this article to the erythristic varieties of the polecat and ferret, and particulars have been given of the occurrence of "red" polecats in the Aberystwyth district, together with some evidence that this mutation has appeared comparatively recently, and is inherited according to Mendel's law. In the case of the ferret it is shown that erythrisms is certainly dependant on a Mendelian factor, being dominant to albinism and recessive to the black-brown coloration. Both in the ferret and polecat erythrisms seems to be correlated with increased size, and certainly in the ferret is usually accompanied by a quick temper and general increase of vitality. To the writer the most

important points that have been brought forward appear to be the indication of the Mendelian inheritance of a structural character (type of skull), and the evidence concerning a variation due to the loss of a factor appearing and maintaining itself in a state of Nature—i.e. the erythristic polecats of Cardiganshire.

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5. PUNNETT, R. C. 1911. *Mendelism*.



Fig. 1. F_1 Ferret-Polecats at eight weeks old.

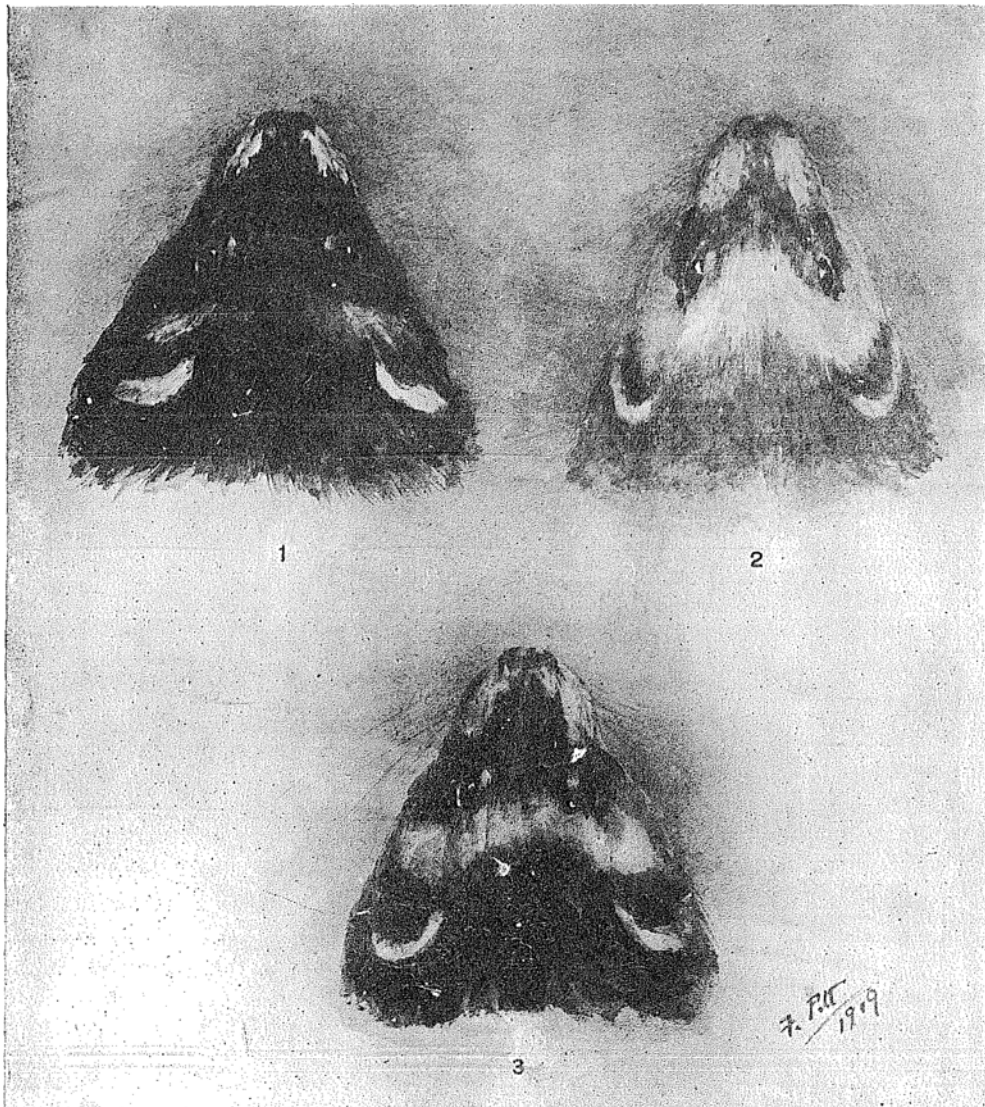


Fig. 2. Polecat (σ) from Cardiganshire.



Fig. 3. Dark coloured σ ferret.

All the above photographs are from life.



1. Head of Polecat ♂.
2. Head of Ferret ♂.
3. Head of F_1 ♂.