

litter were taken, one pair being given small quantities of extract of pars anterior, the other pair used as a control. The animals fed with the extract bred sooner and oftener than the controls. Posterior lobe extract of pituitary gland had no such effect.

Conclusions.—The following conclusions seem warranted:

I. Pituitary extract, and particularly extract of pars anterior, has a markedly stimulating effect upon the growth and development of the reproductive glands in young rats of both sexes, as evidenced by histological examination.

II. Extract of pars anterior tends to cause early and frequent breeding. Posterior lobe extract has no such effect.

III. Posterior lobe and ovarian (corpus luteum) extracts apparently do not stimulate sexual development.

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On the correlation between the number of mammæ of the dam and size of litter in mammals. I. Interracial correlation.

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In his breeding experiments with sheep at Beinn Breagh, Alexander Graham Bell² found that as the number of nipples of the ewes increased there was a tendency towards a more frequent production of twins and triplets. Regarding this point he says (*loc. cit.*, p. 383): "The indications are that our six-nippled stock will ultimately turn out to be twin bearers, as a rule, when they become fully mature."

In reporting a case of unusually high, and probably inherited, fertility in the cow I have³ noted that the individual exhibiting this high fertility bore two supernumerary mammæ.

There is an obvious teleological aspect to this matter. In a general way it is clear that as the number of young born in a litter increases there must be a compensating increase in the number of

¹ Paper No. 52.

² *Science*, N. S., Vol. 36, pp. 378-384, 1912.

³ *Me. Agr. Exp. Sta. Ann. Rept. for 1912*, pp. 259-282.

mammæ, unless there is some peculiarity of feeding habits in the young which would nullify the advantage, not to say necessity, of having enough nipples to "go around." It would seem, *a priori*, that natural selection should have operated to bring about a high correlation, both intra- and interracial between these two variables, size of litter and number of mammæ of the dam. The purpose of this paper is to present the results of a study of interracial correlation between number of mammæ and size of litter.

DATA.

The most extensive series of statistics regarding size of litter and number of mammæ which I have been able to find is that given by Bellingeri¹ in a treatise on "Mastologia."

Bellingeri gives (*loc. cit.*, p. 84) a table including something over a hundred different species of wild and domestic mammals, representing all the orders of Mammalia, in which so far as possible the following information is given for each species: number of mammæ in the female, number of young born at a birth, breeding season, and certain data respecting breeding and feeding habits. So far as it has been possible to check the records against more modern work they have been found to be in general correct. In using the material all doubtful and incorrect cases which could not be corrected from available literature have been eliminated. Further there are a certain number of species for which information on one or more of the points tabled is lacking. After all these eliminations there are left 90 species for which there are complete (so far as concerns the present problem) and presumably accurate records.

In dealing with the material biometrically it has been necessary to make certain assumptions. In a number of instances the figures given for both number of young and number of mammæ are the limits of the range of intraracial variation rather than the intraracial mode, mean or median. In such cases it is necessary to make an approximation to the intraracial mean before the figures can be entered in a correlation table. In reaching these approxima-

¹ Bellingeri, C. F., "Della fecondita e della proporzione dei sessi nelle nascite degli animali vertebrati, e mastologia, con considerazione anatomico-fisiologici sul numero e posizione delle mamelle," Tome III, Torino, 1849.

tions every endeavor has been made to get as near the actual fact as possible. When no information could be found regarding the point at issue in a particular species it was assumed that the mid-point of the range, as given by Bellingeri, could be taken as the centering point, with sufficient accuracy. It is reasonable to suppose that any errors introduced by making this assumption will not be biased, but will as often be in one direction from the truth as in the other.

The interracial correlation table derived from Bellingeri's data is shown in Table I.

TABLE I.

SHOWING THE INTERRACIAL CORRELATION SURFACE FOR THE VARIABLES (a) NUMBER OF MAMMÆ, (b) NUMBER OF YOUNG AT A BIRTH.

Mammæ of Dam.	Size of Litter.														Totals.	
	1-1.9	2-2.9	3-3.9	4-4.9	5-5.9	6-6.9	7-7.9	8-8.9	9-9.9	10-10.9	11-11.9	12-12.9	13-13.9	14-14.9		15-15.9
2- 3.9	26	4	2	1	1	—	—	1	—	—	—	—	—	—	—	35
4- 5.9	11	—	3	—	2	—	—	—	1	—	—	1	—	—	—	18
6- 7.9	—	2	3	2	2	—	1	—	1	—	—	—	—	—	—	11
8- 9.9	—	1	1	2	3	—	2	1	—	—	—	—	—	—	—	10
10-11.9	—	—	2	2	2	2	—	—	2	—	—	—	—	—	1	11
12-13.9	—	1	—	—	1	2	—	—	—	—	—	—	—	—	1	5
Totals	37	8	11	7	11	4	3	2	4	0	0	1	0	0	2	90

TABLE II.

CONSTANTS OF VARIATION DEDUCED FROM TABLE I.

Character.	Mean.	Standard Deviation.	Coefficient of Variation.
Number of mammæ	6.09 ± .23	3.25 ± .16	53.45 ± 3.36
Number of young at birth	3.92 ± .22	3.05 ± .15	77.80 ± 5.81

Coefficient of correlation $r = .594 \pm .046$.

From this table the following points are to be noted:

1. Interracially the mean size of litter is approximately two individuals below the mean number of mammæ possessed by the mother. This may be taken as a rough measure of the evolutionary "factor of safety" in regard to these characters.

2. There is relatively (cf. coefficients of variation) somewhat more variation exhibited in size of litter than in number of mammæ.

3. The correlation between these two characters, as measured by the coefficient r , is surprisingly *low*. This result certainly cannot be said to furnish particularly strong evidence that natural selection has had anything to do with fixing the relationship between number of mammæ and size of litter.

Turning next to the regressions it is found that the regression of size of litter on mamma number is sensibly linear. The more interesting and significant regression of number of mammæ of dam on size of litter is non-linear, as is shown by the following constants¹

$$\eta = .7714,$$

$$\zeta = .2426,$$

$$\frac{\sqrt{N}}{.67449} \frac{1}{2} \sqrt{\zeta} = 3.412.$$

The determination of the precise form of the regression equation here cost a good deal of labor. It was finally found to be logarithmic. The following equation expresses the relation between the number of young at birth and the mean number of mammæ of the dam, the constants having been determined by graduation of the first five means of arrays. Beyond that point resort is had to extrapolation, since the number of observations is too small to give reliable results.

$$y \text{ (probable mean number of mammæ of dam)} = 3.9616 - .3512x \\ \text{(number of young in litter)} + 8.6208 \log x.$$

For the linear regression of size of litter on mamma number we have

$$x \text{ (probable number of young per birth)} = .5566y \\ \text{(number of mammæ of dam)} + .5331.$$

¹ Cf. Blakeman, *Biometrika*, Vol. IV, pp. 332-351, 1905.