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VII. Note on regression and inheritance in the case of two parents

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have been unsuccessful. It is a hard, pale yellow, brittle resin, nearly insoluble in water, light petroleum, and benzene, but readily dissolved by alcohol, ether, and chloroform. When heated it gradually softens, and is quite fluid at 90° C. Croton-resin has neither basic nor acidic properties; it may be boiled with a mixture of lead oxide and water without being appreciably affected. Ebullition with aqueous potash or soda gradually decomposes it, destroying its vesicating power. The products of this action are several acids, some of which are members of the acetic series. By oxidation of the resin with nitric acid a mixture of acids is obtained. The constitution of croton-resin is therefore complicated, and its molecular formula would appear to be at least $(C_{13}H_{18}O_4)_2$ or $C_{26}H_{36}O_8$. Since it is not saponified by a mixture of lead oxide and water, and as no glycerol could be detected among the products of its decomposition by alkalis, it is not a glyceride, and as it does not react with hydroxylamine or phenylhydrazine or sodium bisulphite, it is probably neither a ketone nor an aldehyde. The evidence so far obtained points to the conclusion that the constitution of the vesicating constituent of croton oil is that of a lactone or anhydride of complicated structure.

VII. "Note on Regression and Inheritance in the Case of Two Parents." By Karl Pearson, University College, London. Communicated by Francis Galton, F.R.S. Received June 5, 1895.

Consider a population in which sexual selection and natural selection may or may not be taking place. Assume only that the deviations from the mean in the case of any organ of any generation follow exactly or closely the normal law of frequency, then the following expressions may be shown to give the law of inheritance of the population.

Let H_2 = deviation of the father from mean of the total population of fathers, and let σ_2 = the standard deviation of the total population of fathers.

Let H_3 and σ_3 be the corresponding quantities for the mother for the same (or any other) organ. Let H_1 be the mean deviation of the offspring (fraternity) due to fathers H_2 and mothers H_3 with regard to the same (or any other) organ, and let σ_1 be the standard deviation of the whole offspring population. If we are dealing with offspring of one sex, both the mean and the standard deviation of the offspring may differ, owing to natural selection, by any amount from those of parents of the same sex.

Let r_1 = co-efficient of correlation (Galton's function*) for the two organs (or same organ) of the parent population, *i.e.*, r_1 is a measure of the amount of sexual selection between the parents of the population with regard to these organs.

Let r_2 = co-efficient of correlation between fathers and offspring for the organ (or two organs) under consideration, *i.e.*, r_2 is a measure of the paternal inheritance.

Let r_3 = co-efficient of correlation between mothers and offspring for the organ (or two organs) under consideration, *i.e.*, r_3 is a measure of the maternal inheritance.

The value of H_1 is given by

$$H_1 = \frac{r_2 - r_1 r_3}{1 - r_1^2} \frac{\sigma_1}{\sigma_2} H_2 + \frac{r_3 - r_1 r_2}{1 - r_1^2} \frac{\sigma_1}{\sigma_3} H_3,$$

and the standard deviation Σ of the fraternity due to parents H_2 and H_3 is given by

$$\Sigma = \frac{\sigma_1}{\sqrt{(1 - r_1^2)/(1 - r_1^2 - r_2^2 - r_3^2 + 2 r_1 r_2 r_3)}}.$$

Thus the distribution of fraternities is the same for all parentages; it depends, however, upon the strength of sexual selection, and on the paternal and maternal inheritances for the community at large with regard to the organs under consideration.

The portion of regression due to either parent alone is not dependent solely on maternal or paternal inheritance; it is influenced not only indirectly by sexual selection but directly by the inheritance from the other parent owing to the presence of the terms $r_1 r_3$ and $r_1 r_2$. Further, the greater the variability of one sex (*i.e.*, the greater σ_2 or σ_3) the less, other things being the same, the parent of that sex contributes to the inheritance of the offspring. The above two formulæ seem to embrace the chief laws of heredity in populations. The whole of the constants involved can be found by comparatively simple measurements, and, indeed, have been, to some extent, found in the case of man by Mr. Galton.†

* The probable error of a determination of Galton's function

$$= 0{\cdot}674506 \frac{1 - r_1^2}{\sqrt{n}(1 + r_1^2)},$$

where n is the total number of correlated pairs. Mr. Galton having kindly placed at my disposal his 'Family Faculty Records,' I find that r_1 for height is, as he supposed, small, = 0·093. But the probable error of the determination (n = 198 only) is 0·047. Hence the balance of probability is in favour of a certain small amount of sexual selection as to height in human marriage. I hope shortly to have sufficient data to confirm this result.

† They do not seem, however, to fully justify his theory of the midparent. I hope at a later date to discuss its special limitations, *e.g.*, σ_2 and σ_3 differ considerably in several series of skull measurements with which I have had to deal.

These results are taken from a longer paper on panmixia and regression, which ill-health has prevented my completing up to the present date.

VIII. "On the Occlusion of Oxygen and Hydrogen by Platinum Black. (Part I.)" By LUDWIG MOND, F.R.S., WILLIAM RAMSAY, Ph.D., F.R.S., and JOHN SHIELDS, D.Sc., Ph.D. Received June 13, 1895.

(Abstract.)

The authors describe some preliminary experiments on the occlusion of oxygen and hydrogen by platinum sponge and foil, which in general confirm the results obtained by Graham. At most only a few volumes of these gases are occluded by the more coherent forms of platinum.

After giving details of what they consider the best method of preparation of platinum black, they next describe some experiments which had for their object the determination of the total quantity of water retained by platinum black, dried at 100° C., and the amount of water which can be removed from platinum black at various temperatures in vacuo. As the result of these experiments they find that platinum black dried at 100° retains in general 0·5 per cent. of water, and this can only be removed in vacuo at a temperature (about 400°) at which the black no longer exists as such, but is converted at least partially into sponge. At any given temperature the water retained by platinum black seems to be constant. The density of platinum black dried at 100° C. is 19·4, or allowing for the water retained by it at this temperature, 21·5.

The amount of oxygen given off by platinum black at various temperatures was determined. Altogether it contains about 100 volumes of oxygen; the oxygen begins to come off in quantity at about 300° C. in vacuo, and the bulk of it can be extracted at 400° C., but a red heat is necessary for its complete removal. Small quantities of carbon dioxide were also extracted, chiefly between 100—200° C.

In determining the quantity of hydrogen occluded by platinum black the authors have carefully distinguished between the hydrogen which goes to form water with the oxygen always contained in platinum black, and that which is really absorbed by the platinum *per se*. Altogether about 310 volumes of hydrogen are absorbed per unit volume of platinum black, but of this 200 volumes are converted into water, or only 110 volumes are really occluded by the platinum. Part of it can be again removed at the ordinary temperature in vacuo; by far the larger portion can be extracted at about 250—300° C., but a red heat is necessary for its complete removal. The amount of hydro-