CHAPTER XII.

SUMMARY

THE investigation now concluded is based on the fact that the characteristics of any population that is in harmony with its environment, may remain statistically identical during successive generations. This is true for every characteristic whether it be affected to a great degree by a natural selection, or only so slightly as to be practically independent of it. It was easy to see in a vague way, that an equation admits of being based on this fact; that the equation might serve to suggest a theory of descent, and that no theory of descent that failed to satisfy it could possibly be true.

A large part of the book is occupied with preparations for putting this equation into a working form. Obstacles in the way of doing so, which I need not recapitulate, appeared on every side; they had to be confronted in turns, and then to be either evaded or overcome. The final result was that the higher methods of statistics, which consist in applications of the law of Frequency of Error, were found eminently suitable for expressing

the processes of heredity. By their aid, the desired equation was thrown into an exceedingly simple form of approximative accuracy, and it became easy to compare both it and its consequences with the varied results of observation, and thence to deduce numerical results.

A brief account of the chief hereditary processes occupies the first part of the book. It was inserted principally in order to show that a reasonable *a priori* probability existed, of the law of Frequency of Error being found to apply to them. It was not necessary for that purpose to embarrass ourselves with any details of theories of heredity beyond the fact, that descent either was particulate or acted as if it were so. I need hardly say that the idea, though not the phrase of particulate inheritance, is borrowed from Darwin's provisional theory of Pangenesis, but there is no need in the present inquiry to borrow more from it. Neither is it requisite to take Weissmann's views into account, unless I am mistaken as to their scope. It is freely conceded that particulate inheritance is not the only factor to be reckoned with in a complete theory of heredity, but that the stability of the organism has also to be regarded. This may perhaps become a factor of great importance in forecasting the issue of highly bred animals, but it was not found to exercise any sensible influence on those calculations with which this book is chiefly concerned. Its existence has therefore been only noted, and not otherwise taken into account.

The data on which the results mainly depend had to be

collected specially, as no suitable material for the purpose was, so far as I know, in existence. This was done by means of an offer of prizes some years since, that placed in my hands a collection of about 160 useful Family Records. These furnished an adequate though only just an adequate supply of the required data. In order to show the degree of dependence that might be placed on them they were subjected to various analyses, and the result proved to be even more satisfactory than might have been fairly hoped for. Moreover the errors in the Records probably affect different generations in the same way, and would thus be eliminated from the comparative results.

As soon as the character of the problem of Filial descent had become well understood, it was seen that a general equation of the same form as that by which it was expressed, also expressed the connection between Kinsmen in every degree. The unexpected law of universal Regression became a theoretical necessity, and on appealing to fact its existence was found to be conspicuous. If the word "peculiarity" be used to signify the difference between the amount of any faculty possessed by a man, and the average of that possessed by the population at large, then the law of Regression may be described as follows. Each peculiarity in a man is shared by his kinsmen, but *on the average* in a less degree. It is reduced to a definite fraction of its amount, quite independently of what its amount might be. The fraction differs in different orders of kinship, becoming smaller as they are more remote. When the

kinship is so distant that its effects are not worth taking into account, the peculiarity of the man, however remarkable it may have been, is reduced to zero in his kinsmen. This apparent paradox is fundamentally due to the greater frequency of mediocre deviations than of extreme ones, occurring between limits separated by equal widths.

Two causes affect family resemblance; the one is Heredity, the other is Circumstance. That which is transmitted is only a sample taken partly through the operation of "accidents," out of a store of otherwise unused material, and circumstance must always play a large part in the selection of the sample. Circumstance comprises all the additional accidents, and all the peculiarities of nurture both before and after birth, and every influence that may conduce to make the characteristics of one brother differ from those of another. The circumstances of nurture are more varied in Co-Fraternities than in Fraternities, and the Grandparents and previous ancestry of members of Co-Fraternities differ; consequently Co-Fraternals differ among themselves more widely than Fraternals.

The average contributions of each separate ancestor to the heritage of the child were determined apparently within narrow limits, for a couple of generations at least. The results proved to be very simple; they assign an average of one quarter from each parent, and one sixteenth from each grandparent. According to this geometrical scale continued indefinitely backwards, the total heritage of the child would be

accounted for, but the factor of stability of type has to be reckoned with, and this has not yet been adequately discussed.

The ratio of filial Regression is found to be so bound up with co-fraternal variability, that when either is given the other can be calculated. There are no means of deducing the measure of fraternal variability solely from that of co-fraternal. They differ by an element of which the value is thus far unknown. Consequently the measure of fraternal variability has to be calculated separately, and this cannot be done directly, owing to the small size of human families. Four different and indirect methods of attacking the problem suggested themselves, but the calculations were of too delicate a kind to justify reliance on the R.F.F. data. Separate and more accurate measures, suitable for the purpose, had therefore to be collected. The four problems were then solved by their means, and although different groups of these measures had to be used with the different problems, the results were found to agree together.

The problem of expressing the relative nearness of different degrees of kinship, down to the point where kinship is so distant as not to be worth taking into account, was easily solved. It is merely a question of the amount of the Regression that is appropriate to the different degrees of kinship. This admits of being directly observed when a sufficiency of data are accessible, or else of being calculated from the values found in this inquiry. A table of these Regressions was given.

Finally, considerations were offered to show that latent elements probably follow the same law as personal ones, and that though a child may inherit qualities from any one of his ancestors (in one case from this one, and in another case from another), it does not follow that the store of hidden property so to speak, that exists in any parent, is made up of contributions from all or even very many of his ancestry.

Two other topics may be mentioned. Reason was given in p. 16 why experimenters upon the transmission of Acquired Faculty should not be discouraged on meeting with no affirmative evidence of its existence in the first generation, because it is among the grandchildren rather than among the children that it should be looked for. Again, it is hardly to be expected that an acquired faculty, if transmissible at all, would be transmitted without dilution. It could at the best be no more than a variation liable to Regression, which would probably so much diminish its original amount on passing to the grandchildren as to render it barely recognizable. The difficulty of devising experiments on the transmission of acquired faculties is much increased by these considerations.

The other subject to be alluded to is the fundamental distinction that may exist between two couples whose personal faculties are naturally alike. If one of the couples consist of two gifted members of a poor stock, and the other of two ordinary members of a gifted stock, the difference between

them will betray itself in their offspring. The children of the former will tend to regress; those of the latter will not. The value of a good stock to the well-being of future generations is therefore obvious, and it is well to recall attention to an early sign by which we may be assured that a new and gifted variety possesses the necessary stability to easily originate a new stock. It is its refusal to blend freely with other forms. Some among the members of the same fraternity might possess the characteristics in question with much completeness, and the remainder hardly or not at all. If this alternative tendency was also witnessed among cousins, there could be little doubt that the new variety was of a stable character, and therefore capable of being easily developed by interbreeding into a pure and durable race.