CHAPTER II

GERM-PLASM AND BODY, THEIR MUTUAL INDEPENDENCE

IN the last chapter we discussed two biological principles which, if clearly grasped, greatly simplify an understanding of the process of heredity. These are as follows:

(1) A sexually produced individual arises from the union of two reproductive cells (or gametes), each of which contains, so far as heredity is concerned, a full material equipment for the production of a new individual. Accordingly, the newly produced individual is two-fold or duplex as concerns the material basis of heredity.

(2) If the new individual becomes adult and forms gametes, the production of these will be attended by a reduction to the simplex or single condition as regards the material basis of heredity.

To these two principles we may now add a third, viz.:—(3) The individual consists of two distinct parts: first, its body destined to die and disintegrate after a certain length of time; and, secondly, the germ-cells contained within that body, capable of indefinite existence in a suitable medium.

The fertilized egg or zygote begins its independent existence by dividing into a number of cells. These become specialized to form the various parts and tissues of the body, muscle, bone, nerve, etc., and by becoming thus specialized they lose the power to produce anything but their own particular kind of specialized tissue; they cannot reproduce the whole. This function is retained only by certain undifferentiated cells found in the reproductive glands and known as germ-cells. They are direct lineal descendants of the fertilized egg itself. If they are destroyed the individual loses the power of reproduction altogether.

External influences which act upon the body may of course modify it profoundly, but such modifications are not transmitted through the gametes, because the gametes are not derived from body-cells, but from germ-cells. This relationship first pointed out by Weismann may be expressed in a diagram, as in Fig. 9. Only such environmental influences as directly alter the character of the germ-cells will in any way influence the character of subsequent generations of individuals derived from those

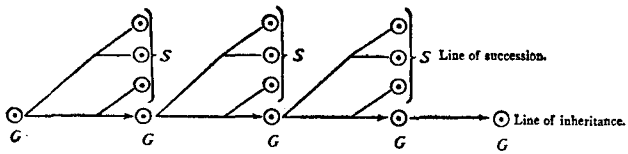

FIG. 9. — Diagram showing the relation of the body (*S*) to the germ-cells (*G*) in heredity. (After Wilson.)

germ-cells. Body (or somatic) influences are not inherited. This knowledge we owe largely to Weismann, who showed experimentally that mutilations are not inherited. The tails of mice were cut off for twenty generations in succession, but without effect upon the character of the race. Weismann also pointed out the total lack of evidence for the then current belief that characters acquired by the body are inherited. The correctness of his view that body and germ-cells are physiologically distinct is indicated by the results obtained when germ-cells are transplanted from one individual to another.

Heape showed some twenty years ago that if the fertilized egg of a rabbit of one variety (for example an angora, i. e. a long-haired, white animal) be removed from the oviduct of its mother previous to its attachment to the uterine wall, and be then transferred to the oviduct of a rabbit of a different variety (for example a Belgian hare, which is short-haired and gray), the egg will develop normally in the strange body and will produce an individual with all the characteristics of the real (angora) mother unmodified by those of the foster mother (the Belgian hare). Young thus obtained by Heape were both long-haired and albinos, like the angora mother. To this experiment the objection might be offered that the transplanted egg was already full-grown and fertilized when the transfer was made, and that therefore no modification need be expected, but if the egg were transferred at an earlier stage the result might have been different. In answer to such a possible objection the follow-

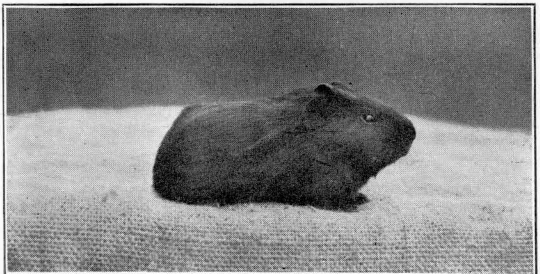

FIG.10.

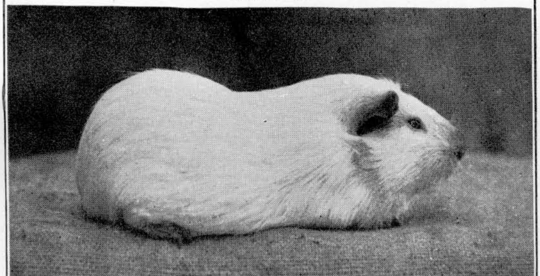

FIG.11.

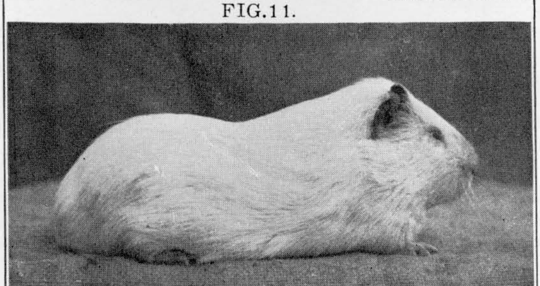

FIG.12.

Fig. 10. — A young, black guinea-pig, about three weeks old. Ovaries taken from an animal like this were transplanted into the albino shown below.

Fig. 11. — An albino female guinea-pig. Its ovaries were removed, and in their place were introduced ovaries from a young, black guinea-pig, like that one shown in Fig. 10.

Fig. 12. — An albino male guinea-pig, with which was mated the albino shown in Fig. 11.

ing experiment performed by Dr. John C. Phillips and myself may be cited.

A female albino guinea-pig (Fig. 11) just attaining sexual maturity was by an operation deprived of its ovaries, and instead of the removed ovaries there were introduced into her body the ovaries of a young black female guinea-pig (Fig. 10), not yet sexually mature, aged about three weeks. The grafted animal was now mated with a male albino guinea-pig (Fig. 12). From numerous experiments with albino guinea-pigs it may be stated emphatically that normal albinos mated together, without exception, produce only albino young, and the presumption is strong, therefore, that had this female not been operated upon she would have done the same. She produced, however, by the albino male three litters of young, which together consisted of six individuals, all *black*. (See Fig. 13.) *The first litter of young* was produced about six months after the operation, the last one about a year. The transplanted ovarian tissue must have remained in its new environment therefore from four to ten months before the eggs attained full growth and were discharged, ample time, it would seem, for the influence of a foreign body upon the inheritance to show itself were such influence possible.

In the light of the three principles now stated, viz. (1) the duplex condition of the zygote, (2) the simplex condition of the gametes, and (3) the distinctness of body and germ-cells, we may proceed to discuss the greatest single discovery ever made in the field of heredity, — Mendel's law.

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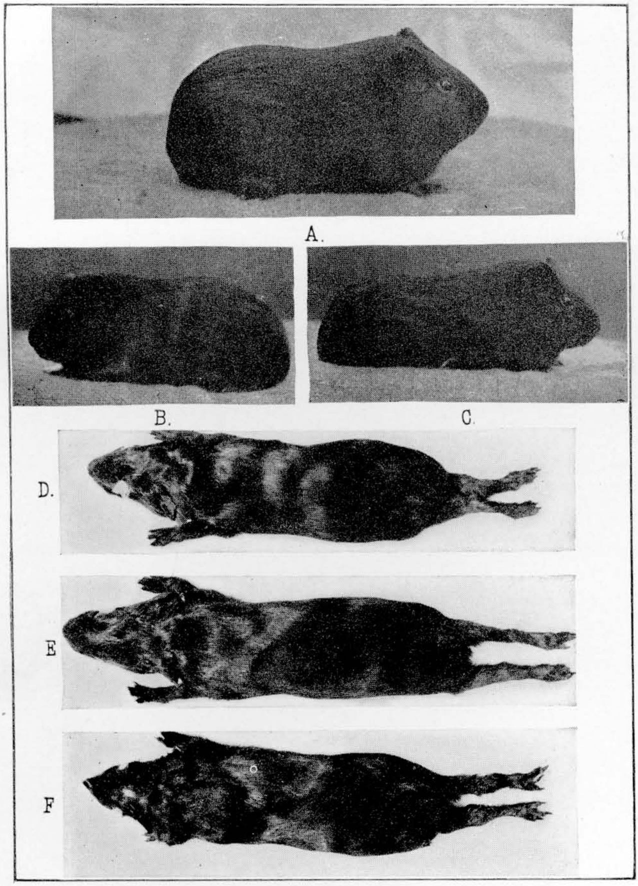

Fig. 13. — Pictures of three living guinea-pigs (*A*, *B*, *C*), and of the preserved skins of three others (*D*, *E*, *F*); all of which were produced by the pair of albinos shown in Figs. 11 and 12.