CHAPTER I

INTRODUCTION

During the whole history of scientific enquiry, one of the most fascinating and at the same time one of the most baffling of the problems which confront mankind has been the cause of the resemblances and differences between parents and children. In general, the facts are common knowledge; the essence of Heredity and Variation is expressed in the proverbs 'Like begets like' and 'Nature never uses the same mould twice.' Yet clearly the two proverbs are contradictory, for if like really begets like Nature must use the same mould for all the members of a family. Our object therefore is to investigate, first, how the characters of a parent actually are distributed among the children, and how the offspring of the same parentage may differ among themselves; and secondly, if possible, what is the mechanism by which the resemblances and diversities are brought about.

These problems are interesting from various points of view. They attract us for their own sake, as does

anything mysterious or unexplained; they have a deep human and practical importance, for not only do they affect us all individually, but upon their solution depends, to an extent as yet only dimly realised, the answer to some of our most pressing social questions; and finally they lie at the very root of all theories of organic evolution, so that they form as it were the basis of philosophical biology. The relation of the study of Heredity and Variation to sociology must be left to a later chapter, but before proceeding further we must shortly consider its bearing on theories of evolution.

The fact of organic evolution is admitted by all schools of biology, but about the causes of the process and the manner in which it takes place there is still wide diversity of opinion. To some of the more important theories of evolution it will be necessary to refer again later, but however great may be the difference of opinion with regard to them, all biologists agree that evolution depends ultimately on Variation and Heredity. Darwin called his great book *The Origin of Species* because the unit step, so to speak, on the scale of evolution is the transition from one species to another. But if a species A is to give rise to a species B, in the first place some individuals of A must vary in the direction of B, and then the variation must be inherited, for otherwise no permanent change can take place. The differences with regard to the cause

and method of evolution arise therefore partly from our ignorance of the laws of variation and heredity, and partly from different ideas as to the causes which lead to progression in certain directions rather than in others. This latter source of disagreement is to a large extent outside the province of this book, but the subjects of Heredity and Variation are so intimately bound together that one cannot be adequately treated without the other. If, however, we can come to any definite decision with regard to the nature of Heredity and Variation, we shall have made a long step towards understanding the method by which evolution has taken and is taking place.

One other point must be mentioned. The study of heredity brings us face to face with perhaps the most fundamental problem of biology—the ultimate nature of living matter. For if an ovum, barely visible to the eye, or the much smaller spermatozoon which is visible only with high magnification, can bear potentially all the parental characters which may be inherited by the offspring, it is clear that any hypothesis of the nature of living matter must take these things into account; and though we cannot unravel or even imagine it, we can at least get some idea of the amazing complexity of the substances which in thoughtless moments we group together under the single name of 'protoplasm.'

We will now attempt, by means of a few examples, to illustrate some of the questions which must be answered, and some of the facts which must be brought into relation, by any consistent account of the process of heredity. A tall man on the average has taller children than a short man, but if all the sons of a number of tall men were measured, it would be found that they showed every gradation in height between the tallest and shortest; some would be taller than the fathers, others shorter, but every gradation between them would occur. Also, if a tall man marries a short wife, the sons are neither all as tall as the father, nor divided sharply into a tall group and a short group; again they make a graded series from short to tall. But if we cross a tall variety of the sweet-pea with a dwarf variety, all the offspring are as tall as the tall parent, and among the offspring of these crossed talls, some are tall and some short, but none are intermediate. Here then we get two distinct modes of inheritance, and also two kinds of variation; in the first case the character varies in such a way that all intermediates are found between the extreme conditions, and in the second the individuals can be classified sharply into two groups. Again, we cross a white mouse or rabbit with a black one, and all the offspring may have the grey-brown colour of the wild animal—we have produced what is called reversion to the wild type, and

have obtained a form different from either parent. But if we mate the same black parent with another white individual, it may happen that all the offspring are black, and instead of reverting to the wild form they all follow one parent. If either the greys or blacks produced in this way are mated together, some of their young will be white; although none of the children of the original white individual resembled their white parent in colour, yet the white has appeared again among the grandchildren after skipping a generation. In man, a colour-blind father rarely has colour-blind children, but some of his nephews and male grandchildren through the female line are usually affected; that is to say, the disease appears in males but is transmitted by females.

It is clear from this short list of examples that there are a number of different forms of hereditary transmission, and our object must be, first to classify them into groups in which the behaviour is similar, and next to attempt to bring them under a common scheme. And it is also clear that the different kinds of heredity are associated with different kinds of variation; for example variation in height in man is inherited differently from variation in colour-vision, and both differ from variation of coat-colour in rabbits, in their inheritance.

A question of a different kind is the cause of inherited differences, and whether differences due to

the action of circumstances are inherited. Does a man, for instance, who develops certain muscles by frequent use, or who injures his health by excessive drinking, have children with larger muscles or poorer health in consequence? The question is frequently answered in the affirmative, but it is part of the province of the study of heredity to investigate the matter, and in these and all other cases to decide not only whether a character is inherited, but, if it is, to what extent and in what manner it will appear in the offspring.