

## INHERITANCE OF HAY FEVER. A PRELIMINARY REPORT\*

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WHEN THE family histories of patients suffering from hay fever are studied, it is at once evident that, in a majority of cases, other members of the family are similarly affected. In some families, different individuals show different forms of sensitivity. Thus the sensitivity may take the form of hay fever, bronchitis, asthma, eczema, urticaria (hives), or migraine (sick headaches). In many cases, all the members of a sensitive family suffer from either asthma or hay fever and, in half the cases studied, the sensitivity is nearly specific for one family.

To determine how the inheritance of hay fever and these allied forms of allergy takes place, a preliminary study was made of twelve families each of which includes one or more patients treated by one of the authors (Balyeat). The histories of these families were obtained from answers to carefully prepared questions. As the patients are of a highly intelligent class, the accuracy of the histories is perhaps greater than may usually be expected in studies of human inheritance.

Since hay fever and other forms of allergy are obviously inherited, and since the transmission may go from father to child, it is obvious that the inheritance must be through the germ cells. The next point to determine is the exact way in which the character is inherited. Does it act as an ordinary Mendelian character and is it dominant or recessive?

Miss June Adkinson (Genetics 1920) has studied a number of histories of a similar nature and considers bronchial asthma to be a recessive character. After a very preliminary study of their histories, the authors conclude that hay fever is not a recessive character. We have a number of cases showing that, after a marriage between an affected individual and a normal person from a negative family, affected children are born. Miss Adkinson would have to consider that in such cases, the normal person was heterozygous. However, if the family history for several generations has shown no cases of allergy, it seems more reasonable to consider normal individuals from such families as unaffected. Family 1 is such a case, for in two cases in this family after a marriage between a normal negative individual and a hay fever sufferer, affected children resulted.

In addition to these cases which show that hay fever may act as a dominant, there are cases, even more frequent, which show that hay fever may skip a generation. Hay fever individuals then result from a marriage between two normal individuals, but always one parent is from an affected family. Family 2 contains a number of matings of this nature. As this family history is typical, complete and also reliable, only two charts are included in this paper.

Obviously hay fever is not a complete dominant and the gene for sensitivity may or may not produce abnormality. This incomplete dominance has its counterpart in cases among animals and plants. In many of these cases, as in heterozygous barred eyes in *Drosophila* and in pink four

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o'clocks, the hybrid is intermediate between the two parents instead of like either one parent or the other.

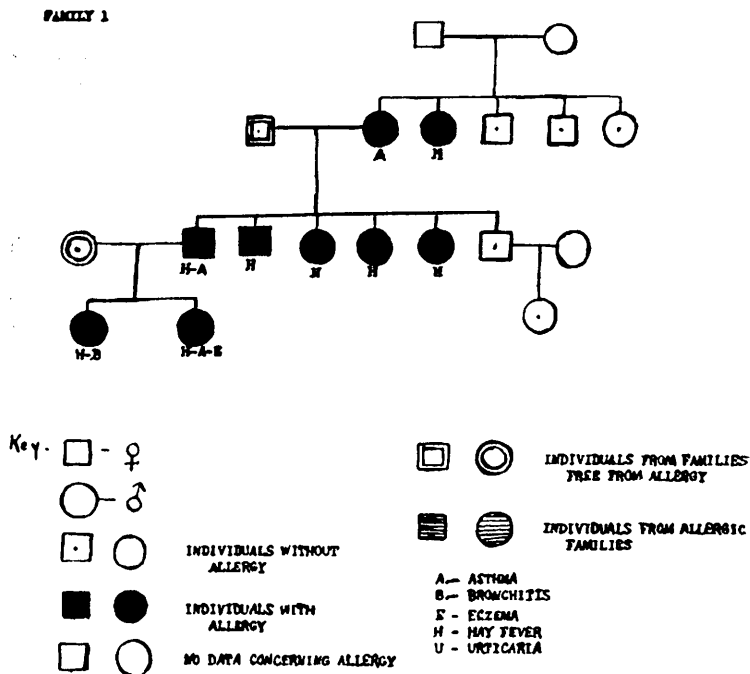
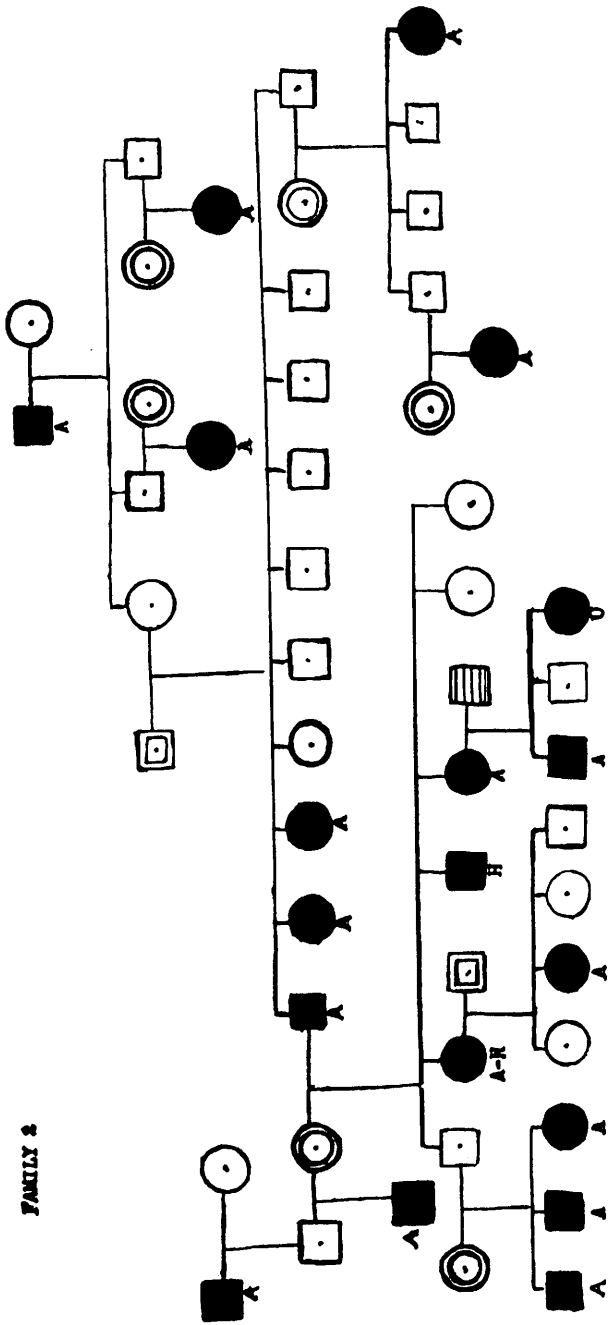


FIGURE 1

The personal history of cases of hay fever and other forms of allergy reveals another interesting fact which may explain the incomplete dominance. The time of appearance of the sensitivity in the ontogeny of the individual differs greatly in different people. In some cases a child develops a sensitivity very shortly after birth and in other cases individuals who have never before had trouble develop a sensitivity at the age of seventy. Between these two extremes are a whole series of ages, at any of which a sensitivity may develop. Consequently, if an individual belongs to an affected family, although he may have had no trouble, there is still a great probability that he may later develop it. Thus no chart of an affected family can ever be considered as complete, for those once classed as normal may later develop some form of allergy.

Another point must also be considered. In order for any form of sensitivity to become manifest there must be, in addition to the sensitivity, the external factor that causes the trouble. A child sensitive to certain forms of



FAMILY 2

FIGURE 2

protein will not develop urticaria or eczema unless he eats that protein. Similarly an individual sensitive to a certain kind of pollen develops hay fever only when exposed to that pollen. In recent years much has been added to our knowledge of the interaction of heredity and environment. Apparently the study of inheritance of hay fever, etc., reveals another case in which a definite environment as well as a definite inheritance is necessary to produce a definite character.

Since an individual who has one form of sensitivity often develops some other form as well, it seems likely that there may be only one factor concerned. However, since some of the families studied show only one type—as hay fever, there is open the possibility of modifying factors which would alter the type of sensitivity. Our numbers at present do not justify us in making any definite conclusion with respect to the number of genes concerned.

Our conclusion is that hay fever is an incompletely dominant character depending partly on the environment for its fulfillment.