

## DOMINANCE IN MAN, WITH ESPECIAL REFERENCE TO POLYDACTYLISM.\*

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The determination of the dominance or recessiveness of any human character often presents difficulties. Most of the known human hereditary characters are recorded in small family histories, which by themselves are not sufficient to establish the dominance or recessiveness of the factor. Yet a factor which appears in each generation recorded, even though the family history be a small one, is usually stated to be a dominant. That this statement may not always be true can be readily shown by the histories of polydactylism given below.

As human heredity becomes better understood, the genetecist is more often called upon to give advice on the probability of certain characters appearing in the offspring of certain marriages. The requests are frequently from prospective mothers who wish to be reassured in the matter of certain undesired traits which have appeared in their ancestry. A thorough and accurate knowledge of the mode of the inheritance of any character is of course necessary before any statements as to the probability of its appearance in the offspring may be made, and the genetecist may well be chary of his advice.

That the difficulty of distinguishing a true dominant in man is not always understood may be realized from the following quotation from the recent syllabus of the introductory course in the biological sciences at a large and well known University. The statement is made, in connection with human heredity, that "It is not difficult to determine whether a trait is a dominant or recessive. If a trait appears in at least one of the parents, in at least one of the grandparents, and in at least one member of other ancestral generations, it must be dominant." The arbitrary application of such a principle may result in errors, especially in human pedigrees which are frequently short and which almost invariably start with a generation which actually shows the character.

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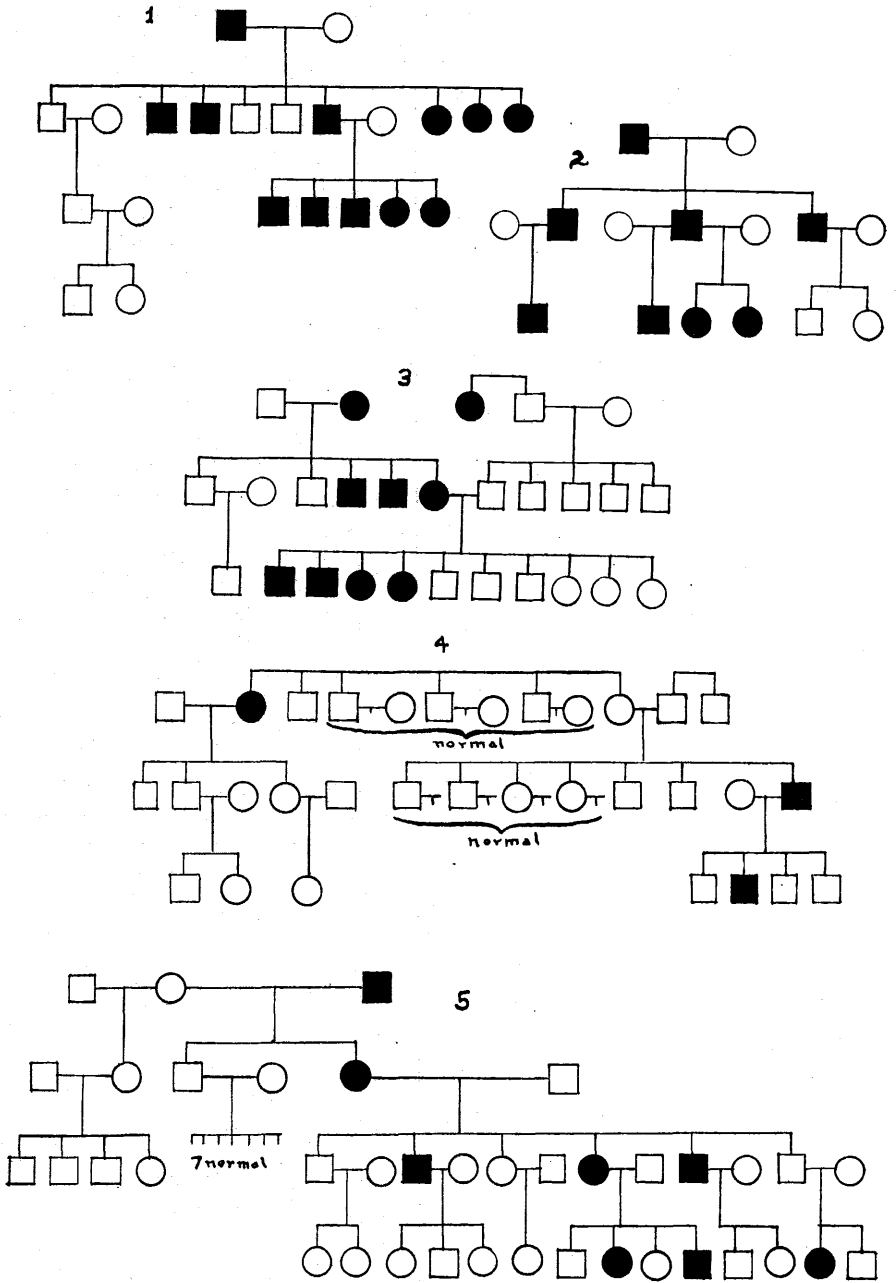
As a case in point may be cited some evidence on hand in our laboratory on the question of polydactylism. This character in white people is usually considered a dominant, because in general it appears to be handed down directly from parent to offspring. The available cases are comparatively few, however, and may not necessarily indicate dominance. The following new pedigree is typical of the kind usually recorded (Figure 1).

Here the character is handed down for three generations without a break. As is normally the case, however, nothing is known of the generation preceding the first in which the character is recorded. Such a pedigree would immediately be stamped as that of a dominant character. The pedigree to be given next will, however, show that this must not be taken for granted.

It is admitted that for the character to be recessive in the foregoing pedigree the mothers of the polydactylous children must in both cases have been heterozygous, and that the odds against this being so are enormous, but it must not be forgotten that these conditions are the very ones whose occasional occurrence bring the pedigree to our attention. When we read a story of a succession of amazing incidents happening to a man, we are prone to dismiss it with the observation that such a series of things would almost never happen, forgetting that the very fact that they did in this case happen may provide the only motive for the writing of the story. Thus the isolated occurrence of a character in a family passes by unrecorded time and again, while the repeated occurrence, from whatever cause, is noted and recorded. We have on record several cases of polydactylism in white people in which neither parent showed the character.

More critical data are provided in the case of polydactylism in negroes. The following pedigree was recently obtained in Columbus with the aid of Dr. J. H. Mitchell, (Figure 2).

This would appear to be the regulation dominant, and would be unhesitatingly called so if the principle cited at the beginning of this paper were followed. However, in a previous paper, one of us (L. H. S.) has shown that polydactylism in negroes is a recessive. It is not impossible that this is the same gene. Many parts of the original pedigree (Snyder, 1929) showed characteristics common to a dominant trait. Only upon careful examination of the more extensive record of the family history did it appear that the character must



be recessive. Figure 3, another new pedigree of polydactylism in negroes, while again appearing at first glance dominant, shows more clearly that it may well be recessive, as the character appears in both lines of the family.

Finally figure 4, likewise a new pedigree in negroes, shows a clear case in which neither parent showed the character and yet transmitted it to a child. While this one case might only indicate the presence of an inhibitor or some other interaction of the factors concerned, reference to the original pedigree cited above will show this to be of frequent occurrence.

An interesting pedigree is offered in this connection in figure 5. This is a case of syndactyly in whites. The character appears dominant, but one case is shown where an abnormal child was born of normal parents. This family is especially interesting in that all syndactylous individuals had also six toes, while the normal individuals had the usual five toes. The number of fingers was in all cases normal. This may indicate a close linkage between syndactyly of the hands and polydactyly of the toes in this family.

In the case of a human character, then, which in a small pedigree or a series of small pedigrees appears in each generation, it is not adequate to arbitrarily designate it a dominant. The following possibilities must always be considered.

1. The factor may, of course, be a true dominant, a fact, however, the proof of which will require far more than the usual small pedigrees.

2. It may be a recessive, most frequently brought to our attention and recorded in pedigree form in those relatively rare cases in which an individual showing the character has married a heterozygote.

3. It may be brought about by any one of duplicate genes, certain of which may be dominant and others recessive.

4. There must always be considered the interaction and epistatic relationships of more than one pair of factors.

5. The character may occasionally appear due to a purely developmental abnormality simulating the hereditary condition, thus complicating the interpretation of family histories.

It must not be forgotten that even if the gene apparently is a dominant we usually have no way of knowing the composition of the homozygous mutant form. In many cases this may be lethal, so that the gene is really intermediate.

If one form of polydactylism is really dominant, as has been considered, the occurrence of a completely recessive form in other families throws an interesting side-light on Fischer's theory of the evolution of dominance. It becomes necessary to explain why one form of polydactylism has become recessive while another phenotypically indistinguishable form is dominant. This fact would favor Wright's suggestion that while the most frequently *occurring* mutations are recessive, those actually fixed in evolution may be either dominants or recessives, thus making it unnecessary to assume the evolution of dominance in new type genes.

#### BIBLIOGRAPHY.

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**Snyder, L. H.** 1929. A Recessive Factor for Polydactylism in Man. Jour. Hered. XX: 73-77.  
**Wright, S.** 1929. Fisher's Theory of Dominance. Amer. Nat. LXIII: 274-279.

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#### Heredity.

The second edition of a genetics text-book by a working genetecist makes its appearance five years after the publication of the original edition. The new book is an improvement over the old one, most especially in the addition of problems to be worked at the conclusion of the various chapters on types of inheritance. Much new material on human inheritance and its various practical applications is included, and certain worth-while additions are apparent in the fundamental chapters.

The author has proceeded on the commendable assumption that many students who would otherwise not obtain any instruction in biology can be led to a knowledge of the subject through an interest in human biology and especially human heredity. The book therefore assumes no previous biological instruction for its readers. Certain elementary facts concerning cells and development are therefore included where needed. The book appears to be exceptionally well suited to the elementary course in heredity, where an increasing knowledge of human inheritance makes it essential that more and more of this valuable material be used in developing an intelligent interest among students.—L. H. S.

**Heredity**, by A. F. SHULL. Second edition, xv+345 pp. New York, McGraw-Hill Book Co., 1931. \$3.00.