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AN INHERITED EYE DEFECT IN THE GUINEA PIG [1, 2]

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MATERIAL AND METHODS

The data presented in this paper were obtained from the descendants of one defective-eyed male guinea pig that appeared in our colony several years ago. Notation was made of the defective eye, but as the male was being used in another experiment no matings were made at that time to determine whether the condition was genetic. However, when the same type of defect was later observed in the inbred descendants of this male, some matings were made to determine, if possible, the manner of inheritance of the condition.

The defect manifests itself in a number of ways, these varying from a microphthalmia, which is usually accompanied by an unusual sensitiveness of the eye, to a dulling or drying of the cornea. In the more severe cases the eye is covered with varying degrees of a white purulent-like exudate. This abnormality is present at birth and usually remains through life in about the same degree of intensity. The condition may influence both eyes, or only one, or one eye may show a pronounced and the other a slight defect. By selection, however, it has been possible to obtain stocks in which the condition is well developed in both eyes of most individuals. In those young animals in which the defect is but slightly developed, it is sometimes difficult to determine whether they should be classified as normal or defective, although this difficulty is never encountered for the more pronounced cases. Some animals which exhibit border-line grades of the defect at birth later appear normal. Dissections of the eyes of defective individuals indicate that the lens, retina and surrounding tissues are normal. Some histological preparations have been made which indicate that the defect involves the cornea, although these studies, as yet, are incomplete.

Observations were made first on the guinea pigs shortly after birth and at varying intervals up to the age of thirty days. Individuals showing the defect were classified into three categories. Where an individual had the condition in both eyes, the same

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classification was used, although in this case the eye manifesting the worst condition was the deciding factor as to the degree of defectiveness. In this way each individual was accredited with the highest grade of defect present. Those individuals having an unquestioned defect as manifested by a dulling and drying of the cornea or a microphthalmia, were classified as grade one, preceded by the letters R, L, or B, depending upon whether the defect was in the right eye alone, the left eye only, or in both eyes. The class, grade two defective, includes all individuals having a pronounced development of the abnormality as manifested by an unquestioned opacity which remains unchanged through the period of observation. If an individual was classified as slightly defective at birth and later as normal-eyed, he was placed in grade three with the letter prefixes as designated above.

Results

In summarizing the data for this study, individuals were recorded by separate matings according to normalities and defects. The consideration of the specific defective eye was omitted, for it was believed that a defect in either eye was sufficient for classification.

Table I shows the results of all matings involving the defective eye. Six matings of normal, unrelated animals with defective individuals produced 45 normal progeny, three with a slight evidence of the defect at birth, but later becoming normal, and one female that was clearly defective. Seven matings of normal, heterozygous males with normal females produced 28 normal offspring and five defectives, one of the latter showing the defect only at birth. Fourteen matings of defective with heterozygous normal individuals produced 39 normal animals, 37 defective, and six showing a trace of the defect at birth. Another series of fourteen matings of defective males and females gave 53 animals showing clearly developed defects, three showing the defect at birth but later appearing normal, and four offspring classed as normal.

Table I. Distribution of Normal and Defective-Eyed Progeny in Various Types of Matings

Matings	Normal	Grades Defective			Total	
		1	2	3	Nor.	Def.
Unrelated normals × Defective	45	0	1	3	45	4
Heterozygous normals × Homozygous normals	28	1	3	1	28	5
Defectives × Heterozygous normals	39	3	34	6	39	43
Defectives × Defectives	4	3	50	3	4	56

From the data in Table I, it would seem possible to consider the inheritance of this eye defect as due to the action of a single major factor incompletely recessive in nature. Of the four defective offspring resulting from the matings of unrelated normals with defective individuals, three progeny were defective grade 3, that is, they outgrew the defect before thirty days, while the fourth defective individual from these matings was a grade 2. This indicates that the defect is sometimes incompletely recessive to the normal condition, or that it may be influenced by modifying genes. The appearance of defective progeny in the matings of normal with heterozygous normal individuals would lead to the same conclusion. The normal offspring observed in the matings of defective animals may possibly be explained by the action of modifying genes which, in certain genotypic combinations suppress the action of the major defective gene so that it is not manifested phenotypically, thus accounting for the occasional appearance of a normal offspring from two defective parents. A second possibility is that such individuals contain the normal allelomorph of the major defective gene, but that the defect became manifested because of the action of modifying genes favoring the condition. The mere fact that different grades of the defect exist indicates that there are other factors operating. The four normal progeny in the matings of defectives with defectives (table I) came from four matings in which the defect was not developed phenotypically in the most pronounced degree. One parent, for example, was classified as L3 showing that it was a border-line case. The sires and dams of the other normal individuals were also incompletely defective having the condition only in one eye. A final explanation accounting for the appearance of these exceptional types in a few matings must await the results of further observations.

Guyer and Smith (1920) observed a somewhat similar irregular behavior of an inherited eye defect in rabbits. They believed the defect to be dependent upon multiple factors, thus accounting for an occasional reversal of dominance. Wright (1931) described threshold effects in a polydactylous strain of guinea pigs, a behavior that is somewhat analogous to that of the eye defect reported herein.

Conclusion

From the data presented, it may be tentatively concluded that the inheritance of this congenital eye defect in the guinea pig is due to one major factor, incompletely recessive in nature. It is suggested that the major gene causing the defect may be influ-

enced by plus and minus modifiers, causing its action to be masked in some cases and to be over active in others.

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