AN EARLY FAMILY HISTORY OF COLOR BLINDNESS

Illustrating the Rule That Sons Can Inherit Normal Color Vision Only from Their Mothers, While Daughters May Inherit It from Either Parent or Both

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IN THE Philosophical Transactions of the Royal Society of London for 1779 is recorded a rather complete family history of color blindness, to which, so far as I am aware, attention has not been called in recent studies on the subject. It consists of a letter from one J. Scott, describing his own condition and that of his near relatives, which was communicated to the Society by the Rev. Michael Lort.² It is of interest because of its early date and because the facts as given fall so perfectly into line with the interpretation of color blindness as a sex-linked character in man.

In describing the imperfection in his own sight Mr. Scott states that he does "not know any green in the world." Pink and pale blue appeared alike; full red and full green the same. He could tell yellows and all degrees of blue except very pale. He was sometimes baffled by full purple and deep blue. In this connection he cites an incident which is so quaint and full of human interest that it may be quoted verbatim. He relates:

"I married my daughter to a genteel, worthy man a few years ago; the day before the marriage he came to my house, dressed in a new suit of fine cloth clothes. I was much disappointed that he should come (as I supposed) in black: said, He should go back to change his colour. But my daughter said, No, no; the colour is very genteel; that it was my eyes that deceived

me. He was a gentleman of the law, in a fine rich claret-coloured dress, which is as much a black to my eyes as any black that ever was dyed."

The accompanying diagram is constructed from the data supplied by Mr. Scott on the occurrence of color blindness in his family. In the following quotation the numbers inserted in brackets show the position of the individual referred to in the diagram. To use then his own words:

"It is a family failing: my father [II 1] has exactly the same impediment: my mother [II 2] and one of my sisters [III 5] were perfect in all colours: my other sister [III 2] and myself [III 3] alike imperfect: my last mentioned sister has two sons [IV 1, 2] both imperfect: I have a son [IV 3] and daughter [IV 4], who both know all colours without exception; and so 'did their mother [III 4]: my mother's own brother [II 3] had the like impediment with me, though my mother, as mentioned above, knew all colours very well."

Using the symbol N for normal vision and n for its allelomorph, and also assuming that N is sex-linked, we may have the following genotypes: NN , homozygous normal female; Nn , heterozygous normal female; nn , color blind female; $N-$, normal male; $n-$, color blind male. It is then possible, on the basis of the data given, to designate the genotypes of all the individuals men-

¹Papers from the Department of Genetics, Agricultural Experiment Station, University of Wisconsin, No. 17. Published with the approval of the Director of the Station.

²Lort, Michael. An account of a remarkable imperfection of sight. In a letter from J. Scott to the Rev. Mr. Whiffon, of Trinity College, Cambridge. Communicated by the Rev Michael Lort, B.D., F.R.S. Philos. Trans. Roy. Soc. Lond., Vol. 68, Part 2, pp. 611-614, 1779.

THE OCCURRENCE OF COLOR BLINDNESS IN ONE FAMILY

The above diagram illustrates the history of color-blindness as it occurred in three successive generations. The father was color blind, and the impediment was inherited by his son and one daughter. The mother and one daughter had perfect eye-sight. The daughter who was color blind had two sons, both with imperfect eyesight. The son also had two children, a boy and a girl, who both, like their mother, had normal color vision. (Fig. 12.)

tioned. For the males this is of course simple, since it may be known from the phenotype. all normal males (IV 3) being N^- and the color blind ones n^- (II 1, 3; III 3; IV 1, 2). In the case of the normal females, on the other hand, the genotype must be ascertained from the known kin. The subject's mother (II 2), for example, was normal, but since she had both a color blind son and daughter she must have been Nn , that is, a "carrier" of color blindness; the son must have inherited the color blindness from his mother,

since it is transmitted only in that way, and a daughter can be color blind only when she inherits it from both parents. The other daughter (III 5) was normal, but must have been heterozygous (Nn) because of her father being color blind. The same rule applies to the subject's own daughter (IV 4). The only other woman described is the subject's wife (III 4), who had normal vision, and who probably was homozygous (NN), for had she been heterozygous the chances would have been even for either the son or the daughter to be

color blind, and considerably less than even that they would both be normal.

As to the conditions of the subject's grandparents (I 1 and 2, 3 and 4), which are not stated, it is possible only to conjecture, though it is apparent that both the grandmothers must have been either color blind or heterozygous for the defect. The grandfathers might have been color blind or not as far as the data go. Nothing further can be said about the paternal grandparents, but the subject's mother having had normal vision it is possible to say that if his maternal grandmother (I 4) was color blind her husband must have had normal vision, whereas if she had nor-

mal vision he must have been color blind. That is, to give the results obtained (heterozygous normal daughter and color blind son) the mating must have been $N- \times m$ or $n- \times Nn$.

It would have been interesting if he had noted the condition of his brother-in-law (III 1), that is, the husband of his color-blind sister (III 2). It was a foregone conclusion that all her sons would have defective vision since she herself was color blind, but any daughters would have served as an index to the father's condition, since their vision would have corresponded to his. As it is, he may or may not have been color blind.

THE GESTATION OF THE CARABAO

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LITTLE is known about the breeding habits of the carabao (*Bos bubalus*), since these animals are on the range most of the time. They rarely go under shelter except during the busy season of harvesting, when they are tied close to the house of the farmer, under a light bamboo and cogon or nipa shed, and are fed on sugar-cane leaves or rice straw. While the crops are growing, the carabaos are used in cultivating the crops, and are grazed on vacant lots, on paths overgrown with grass, or on the roadside. At these times breeding is not likely to occur, as these animals are herded more or less individually by the children of the farmers.

After harvest, all the carabaos in the neighborhood have the run of all the fields in common, since fenced areas are rather rare in the Philippines, and it may be presumed that it is at this period when breeding occurs. Carabaos mature later than cattle, bulls hardly breeding regularly before three years of age, and cows usually bringing their first

young at five, sometimes at four, but rarely before that. Under such conditions it is impossible to determine the exact gestation of the carabao, and an inquiry among the farmers elicits a variety of answers ranging from nine to thirteen months or more.

With the acquisition of a small herd of these animals by the College of Agriculture, the cows were kept separate from the bull from the start, and observations were made on their estrum. The period of estrum of these animals is very obscure, and the only way we succeeded in breeding them was by attempted matings of them at frequent intervals.

The figures obtained so far, while few, are significant, inasmuch as they are fairly uniform. Due to the reasons mentioned above, observations on the period of gestation of this animal will probably never become numerous. At the College we estimate that we lost about half a year on an average for each cow observed by not knowing the exact time when each cow should be bred, due to the obscurity of estrum.