

## CONCERNING A FREE-MARTIN.

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A FRIEND of mine who goes in for breeding cattle showed me recently one of those mysterious and somewhat uncommon quadrupeds known as free-martins. The animal in question was an apparently sterile cow born co-twin with a potent bull. My friend, who is a very intelligent layman, amused me much with his comical explanation of the unwonted birth of the animal; into those explanations I need not enter, but, having dabbled a little in genetics, I was able to give him a more scientific explanation of the occurrence, and as the matter has a general bearing on the theory of the differentiation of sex it may be of interest to readers of this journal.

To begin with, I premise that the reader is more or less familiar with the Mendelian phraseology, and, therefore, would say that a free-martin is a pure or extracted recessive in respect of its genital determinants, and that the potent twin is a pure or extracted dominant, both being of  $F^2$ , in the Mendelian scheme. If the reader be unskilled in recent embryological theorizing, this statement may seem not very helpful, but it will be more comprehensible if it be borne in mind that there is reason to think that, in humans and the vertebrates generally, the female and the male have each not only characteristic sex organs fully developed, but also traces of those of the opposite sex. The conclusion is drawn that the ova and the spermatozoa are gametes, each of two types; thus there are two male gametes of unequal value and two female gametes also of unequal value. One male gamete contains the male sex-unit character, and one female gamete has the female sex-unit character; consequently we may speak of a male sex gamete and a male non-sex gamete, and of a female sex gamete and a female non-sex gamete. A further hypothesis is that the crossing of a male sex gamete with a female non-sex gamete will give a fertilized ovum or zygote, which will develop into a male holophyte or fully developed organism, and that the crossing of a female sex gamete with a non-sex male gamete will give a female holophyte—the sex being determined and unalterable as soon as the zygote is formed.

According to modern teaching, in the male genital unit there are potent and dominant male elements, as represented by the testes, the phallus, prostate and prostatic urethra, scrotum, Wolffian ducts and Wolffian bodies, the gubernaculum and the caudal ligament of the testis; while the non-potent or recessive elements in the male are the mammae, the prostatic utricle, fimbriated ends of Fallopian tubes and the paradidymis. The female genital unit is also represented by potent or dominant female elements and non-potent or recessive female elements. Among the former are the mammae, ovaries, ovarian ligaments, Fallopian tubes, uterus, vagina, hymen and urino-genital sinus. In addition to the foregoing, the round

ligament, labia major and minora, and the glans, are potent and dominant female elements, less fully developed than in the male, but always analogous to a definite continuous segment of the corresponding male organs. On the other hand, the epoöphoron and upper portion of the Wolffian duct, which are equivalent to corresponding fully developed organs in the male, but less perfect in structure, and not equally functional, are regarded as non-potent or recessive female elements.

The practical interpretation of these genetical hypotheses or views is that a free-martin is not a hermaphrodite, but may be one of two types. If born co-twin with a potent bull, such as was the beast belonging to my friend, it is really a sterile male, and, according to the Mendelian scheme, would have originated in the following way. A male sex gamete united with a female non-sex gamete and gave a zygote  $F^1$ ; this, owing to it twinning, gave a bull with equivalent soma and dominant or potent genital organs and a bull with equivalent soma and non-potent genital organs of the female and recessive type. These twins constitute  $F^2$  in Mendelian language, and were the potent bull and the free-martin respectively, the former being a pure or extracted dominant and the latter a pure or extracted recessive and really a sterile male. The other and much rarer type of free-martin is the one born co-twin with a potent cow, and which really is a sterile female. The originating elements in this case being a non-sex male gamete uniting with a female sex gamete. Apart from the question as to how free-martins originate among cattle, the hypothesis of varieties of gametes and the distinction of the genital organs into dominant and recessive or potent and non-potent parts or representatives affords an explanation of the presence in one sex of rudimentary organs of the other as well as of the occurrence of the strange structures known as teratomata or embryomata. The view held generally is that a teratoma arises from a non-sex variety of gamete, that is, that the testicular teratoma is derived from an imperfectly reduced non-sex male gamete, and the ovarian variety from an imperfectly reduced ovum. Obviously, the whole subject is both intricate and difficult, requiring close study and a working knowledge of Mendel's law in all its ramifications; but it would seem that, little by little, some of the most mysterious phenomena of generation and its anomalies are being better understood, and that there is a reasonable hope of disorder being reduced to order and an explanation forthcoming of many matters regarded hitherto as inexplicable. Any one wishing to pursue this subject further will find a suggestive article on differentiation of sex by Berry Hart in the *Transactions of the Edinburgh Obstetrical Society*, vol. xxxiv, pp. 303 to 357, and for additional anatomical knowledge as to free-martins the same worker gives much information in *Proceedings of the Royal Society, Edinburgh*, vol. xxx, pt. 3, pp 230-241.

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