

Genetics of Sex Differentiation

Ursula Mittwoch



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URSULA MITTWOCH

*The Galton Laboratory
Department of Human Genetics and Biometry
University College London
London, England*



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Preface

The role played by chromosomes in the development of male and female characteristics is a topic of exceptional interest. It has been almost seventy years since sex chromosomes were discovered, providing the first real answer to the age-old question as to the cause of sex differentiation. Nevertheless, the hopes of early geneticists to explain the determination of sex in terms of classical Mendelian genetics were never fulfilled. In spite of the accumulation of much pertinent data, no solid evidence could be adduced for the existence of either male- or female-determining genes in *Drosophila* or other organisms. As a result, efforts to unravel the genetics of sex determination were abandoned in favor of investigations which seemed to fit more readily into the Mendelian framework.

This is an opportune time to reinvestigate the problem of sex differentiation for several reasons. The unprecedented progress in the cytogenetics of man and other mammals has focused attention on the relationship between chromosomes and normal, as well as abnormal, sexual development. The large number of sex chromosome abnormalities that have come to light in our own species have forced us to take a closer look at the manifold developmental processes that occur from sex determination (at conception) to sexual maturity. But progress in clinical genetics has been matched by equally far-reaching discoveries of a more fundamental nature. It has become apparent that the chromosomes of higher organisms contain a large amount of DNA and that some of it does not

function in accordance with the genetic code. Furthermore, dramatic advances in our knowledge of this nongenic DNA are continually being made with the aid of newly developed techniques. It is clear that there is a striking correspondence between this part of the DNA and the chromosomal regions that have long been regarded as heterochromatic. It has also long been known that sex chromosomes are particularly rich in heterochromatin.

The purpose of this book is to bring together evidence that the sex chromosomes may affect the rates at which cells divide and that the process of sex differentiation is based on differences in growth rates during development. This has necessitated discussion on a rather wide variety of topics, and no attempt has been made to cover any one exhaustively. Although some of the ideas mentioned are themselves in an early stage of development and no doubt in need of modification, it is hoped that the approach I have chosen—looking beyond the formal gene–phenotype relationship and emphasizing the dynamic relationship between chromosomes and growth—will lead to a better understanding of the role of chromosomes in the development of sexual and other characteristics, i.e., those which are basically of a quantitative nature. The realization that chromosomes, in addition to carrying genes determining chemical specificity, contain other regions which control the rates of cell division and growth should help to ally cytogenetics with embryology and evolution and generally shed light on the interaction between nature and nurture. The process of sex differentiation provides an excellent system to test such correlations.

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