BOOK REVIEWS

Maleness and Femaleness

Sex Determination, Differentiation and Intersexuality in Placental Mammals. R. H. F. Hunter. Cambridge University Press, New York, 1995. xxii, 309 pp., illus., + plates. $79.95 or £50.

The sex of the mammalian embryo is determined at the moment of conception; if the egg is activated by a Y-bearing sperm, the fetus is destined to be male. But determination is not enough, and there is an enormous amount of differentiation that must occur to achieve what we recognize as the adult male phenotype. Prior to sex differentiation, the fetus is sexually neutral, with a primitive undifferentiated gonad and a double set of genital ducts. The first steps in sex differentiation occur in the male and involve changing the bipotential gonad into a testis and subsequent regression of one set of ducts. It is classically held that sex determination in mammals is a simple event in which perhaps only a single gene on the Y chromosome decides whether the generic gonad develops into a testis or an ovary. Female differentiation has been considered the default pathway, as it occurs only in the absence of a proper Y chromosome. After reading this book one will certainly agree with the author that "so splendid an organ as the functional testis (or ovary) must involve programming by many genes." Although he rejects the hypothesis that the road to female sex differentiation is merely a default pathway, there is little here that is contrary to it. The book deals mainly with these processes in the male, because so little is known about female sex differentiation.

Many genes have at one time been considered candidates for the sex determinant on the Y chromosome, including the HY antigen and the ZFY zinc finger protein, and these are discussed along with genes that play a role in the development of genital ducts and external genitalia. Two of them with important roles in male sex differentiation have been identified so far: one, the gene in the sex-determining region of the Y chromosome (SRY), has a pivotal role in the cascade leading to the differentiation of the testes; the other, the autosomal gene encoding the anti-Müllerian hormone (AMH) produced in testicular Sertoli cells, is responsible for the regression of Müllerian ducts, which are the ducts that in females develop into oviducts and uterus. Both are fully discussed with respect to what is known and what remains to be elucidated. We are reminded that despite the ever-increasing amount of detail available, the precise mechanisms underlying the conversion of a primitive gonad into testicular or ovarian tissue and the development of secondary sexual characteristics remain unknown.

Hunter's intent was to write an academic text for advanced undergraduates and graduate students interested in developmental biology and reproductive physiology, and the book is more concerned with physiology and genetics than with chemistry. It is a pleasure to read because of Hunter's clear style and elegant exposition, which, as he points out in another context, "are aspects of scholarship not always conspicuous in the latter part of the twentieth century." It is also a successful amalgamation of information from many mammalian species.

The normal mechanisms of sex determination and normal differentiation of the gonads and genital ducts are considered separately from the anomalous sexual development in domestic species, laboratory rodents, and humans. Each chapter was intended as an essay in its own right, which results in some repetition, but this is not a problem. The material of which I have prior knowledge is accurately summarized, and most of the important references are included. For me the best parts of the book are the first four chapters, dealing with the normal mechanisms, as they not only present the facts but also document well the history of these discoveries, providing insights into the scientific process; novel findings suggest hypotheses, which may later be rejected on the basis of new evidence. Clearly the search for genetic sex determinants has involved several false starts. I am not as enthusiastic about the presentation of abnormal sex differentiation, which seems to lack an organized approach and in many cases especially with respect to domestic animals, is phenomenological, mainly because the sexual phenotypes in those animals have not been well defined physiologically. Furthermore, the term "intersex" seems too general and too vague to be useful for the analysis of aberrations in the sex determination-differentiation pathway. On the other hand, the value of such mutants for elucidating normal mechanisms and as models for future studies is evident. Much of our knowledge about the fate of germ cells and the ontogeny of ovotestis in hermaphrodites comes from studies of XX-XY chimeras—mixed-cell lineages occurring spontaneously in humans and farm animals and those created in tetraparental rodents, which are discussed in the chapter on chimeras. The chapter that considers asymmetries in the reproductive system seems to belabor the matter; aside from the asymmetry in the rate of gonadal growth (testes ahead of ovary), which probably leads to earlier differentiation in the male, and the unexplained unilateral occurrence of ovotestes, the significance of asymmetries—such as unequal growth of left and right gonad and differences in distribution of germ cells and in testicular weights—is far from clear and may turn out to be trivial.

The many figures in the book are generally well done and helpful. The photographs are not as useful, mainly because of poor labeling. However, the frontispiece is an exceptionally fine photomicrograph showing the moment of sex determination in hamster oocytes.

I am pleased to have this concise and well-written summary of what is known and hypothesized about mammalian sex determination and differentiation on my shelf as a reference. The index is excellent, and there are many important references up to 1994.

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Patterns

The Algorithmic Beauty of Sea Shells. HANS MEINHARDT. Springer-Verlag, New York, 1995. xii, 204 pp., illus., + diskette. $49.95, DM78, öS608.40, or sFr75.

One of my earliest memories is of a collection of Kwakiutl hats owned by my paternal grandfather. These hats, common on the West Coast of Vancouver Island when he was a young man, were woven from cedar bark and bore elaborate designs inspired by the highly regular patterns on sea shells, particularly those of surf clams. The hats even looked like clam shells, designed to protect the wearer from the West Coast rains. I often wondered how the clams that inspired these patterns managed to create designs that were so similar from shell to shell and yet also different, both in the regularity of the pattern and in the detail. It seemed clear to me that a blueprint of some