on ancient human burials and cremations in Belgium with a view especially to the presence of pathological processes. One of the main results was a publication entitled *La Race de Furfooz: Son Age, Sa Pathologie* (1963), which Wells has cited.

In the present book the author makes only limited effort to supplement his personal observations (many of them more cultural than medical) with broad geographical comparisons and modern interpretations. Nearly 80 percent of the cited references (many names bear no references) date before 1960, and only one is as recent as 1965. Actually, the most up-to-date statements are those attributed to Wells. And there is no American paleopathology other than that of MacCurdy (1923) and Moodie (1923).

Because of these shortcomings, the book's main value is as an indication of the kind of work being done on the ancient diseases of western Europe. Yet in this limited respect, too, the book is neither comprehensive nor up to date. There is no mention, for instance, of the work of Møller-Christensen of Copenhagen on leprosy or that of Hamperl of Bonn on hyperostosis spongiosa (Janssens does not seem to know that this name has replaced "symmetrical osteoporosis"), and only passing mention of the work of Hackett, formerly of Geneva, on the treponematoses.

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Quantitative Genetics

Population Genetics in Animal Breeding. FRANZ PIRCHNER. Translated from the German edition (Hamburg, 1964) by Franz Pirchner and Max von Krosigk. Freeman, San Francisco, 1969. xiv + 274 pp., illus. $8. Agricultural Science Series.

This book begins with a succinct introduction to the basic concepts of Mendelian genetics and statistics. This is followed by chapters on the genetic structure of populations, forces changing gene frequencies, inbreeding, the genetics of quantitative variation, and several chapters on the theory and methodology of animal breeding. The book is similar to Falconer's *Introduction to Quantitative Genetics* (the best book available to date in this field) but has a more comprehensive treatment of animal breeding topics and a more complete coverage of animal breeding literature (especially of European work) and gives examples from domestic animals whenever possible (students should be particularly appreciative of this).

The book is well written, the translation is well done, and the book is easy to read. The coverage of the subject is excellent. The author's use of biological data to introduce and discuss topics is particularly successful. The most serious defect of the book is the atrocious referencing. There are numerous inaccuracies in text references and in the bibliography, and several references are missing from the bibliography. In a few cases wide coverage of topics is achieved at the expense of clarity; I found the description of linear heritability estimation unintelligible, for example. I was unhappy with the treatment of the importance of gene interaction effects in quantitative inheritance and the question of the number of genes controlling the observed variability for quantitative traits. The author does not mention epistasis as a possible cause of heterosis even though the critical experiments by Robertson and Reeve showed gene interaction effects to be involved, and states that "most or all economic traits are influenced by many genes, with many meaning dozens or even hundreds" without mentioning the evidence from Thoday's group at Cambridge that for the traits they have studied selection response is due predominantly to few genes. The expectations of the sire-daughter and dam-son covariances for sex-linked genes are given (p. 110) as $V(A)/2$ but should be $V(A)/\sqrt{2}$, this being an error in the source reference. The statement "Homozygotes of one kind were superior during the early period while homozygotes of the other kind survived better in the laying house. This caused both kinds of genes to be maintained" (p. 220) could be interpreted to mean that polymorphism can be maintained by selection in different directions at different stages of the life cycle, whereas this is true only when the overall effects of selection lead to heterozygote superiority in fitness.

This book is recommended for courses in quantitative genetics and animal breeding and as a useful source book of domestic animal data for use in population genetics courses.

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Mutagens and Mutants

Mutation as Cellular Process. A Ciba Foundation Symposium, London, Feb. 1969. G. E. W. WOLSTENHOLME and MAEVE O'CONNOR, Eds. Churchill, London, 1969. xii + 244 pp., illus. $9.

The dazzling success of molecular biology in elucidating the basic features of replication, coding, transcription, and translation has extended to the nature of mutation. Thus, the single base substitution involved in missense mutations, the proof of the brilliant proposal of frame shift changes, the use of mutagen specificity in assigning base changes in tobacco mosaic virus and nonsense triplets in T4 phage, the molecular basis for dominance in phages and *E. coli*, and the demonstration of an enzyme system for removal of chemical and radiation-induced lesions from DNA all have contributed to our understanding of mutation. The book *Mutation as Cellular Process* is a reflection, in the words of R. F. Kimball, of the view that "mutation is not just an isolated event, a quantum event, or a simple chemical reaction, but a process in which cellular functions are intimately involved." The papers in the book reflect the immensity of the jump from the application of a mutagen and the fixed alteration in DNA.

Most of the studies of mutation involve the application of an input (mutagen) to a black box (cell or organism) from which an output (mutation frequency) may be determined. By altering factors impinging on (environmental) or within (genotypic) the black box, the output may be modified and some inferences made about the contents of the black box. While studies in vitro permit a more direct measure of the lesions induced in genetic material, the participants in this symposium have amassed a great quantity of data showing that models based on a direct interaction of a mutagen with the genetic material are too simple. The difference in output induced by irradiation of phages extra- and intracellularly (Kaplan, Lohr, and Brendel), by post-irradiation treatment (Clarke; Witkin and Farquharson), by genotypic and environmental differences (Kilbey), by allelic differences (Auerbach), by pairing and recombination (Magni and Sora), and by fractionating the doses and time of administration of radiation (Russell) all impress this fact upon us.

On the other hand, the direct measurement of the effects of ultraviolet irradiation and hydroxylamine (Grossman