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

and Brown), of alkylation (Brookes, Lawley, and Venitt), of ribosome mutants on phenotypic expression (Aspirion and Schlessinger), and of base analogs (Wacker and Chandra) on nucleic acids provides a basis for models of the mechanism of mutation. Furthermore, the demonstration of repair processes that are not artifacts of differential cell survival following mutagenesis has provided a promising approach for interpreting many of the data. The recovery of radiation-sensitive and recombinationless mutants, as well as the isolation of enzymes with the ability to excise radiation- and chemical-induced lesions (Grossman and Brown), promises to give a solid basis to the model.

While the black-box approach to mutation must be used with higher organisms, I suspect that the returns, in terms of basic insights into the mechanisms involved, will not be great. Obviously a great deal of information on the effects of radiation and chemicals on mutation frequencies is needed from a practical standpoint. However, for those like myself who are not directly involved in mutation research, I doubt that the book will provide a broad or penetrating insight into problems in mutation. For mutation experts, the papers probably are too short and lack detail. I found the book a rather dull recitation of how outputs can be modified without any exciting or novel approaches or results. This is another good book for the library to carry in the event some cross reference or specific piece of information is required.

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Macropodidae

Kangaroos. H. J. FRITH and J. H. CALABY. Hurst, London, and Humanities Press, New York, 1969. xvi + 212 pp. + plates. $16.

Kangaroos are controversial in Australia because of conflicts between them and the agricultural industry, the responses of conservationists to reports of their wholesale slaughter, and the apprehension of ecologists that extirpation or even extinction may be their fate unless knowledge and understanding of them are rapidly increased and implemented. Drawing heavily on the historical evidence concerning marsupials large and small, and on current results of investigations by the CSIRO Division of Wildlife Research, Frith and Calaby have produced a searching treatment of the great kangaroos. Because data are available in most abundance on the red kangaroo *Megaleia rufa*, it becomes the type animal and provides the core for the book. The authors are moderates in their views of evolution and classification, explaining satisfactorily that prominent deficiencies in current dogma can be traced to the probability that the living Macropodidae represent end products of not one, but several, lines of descent. Their tentative recommendation for classification of the beasts commonly called kangaroos, the red, the grays, and the euro-wallaroo group, is that these consist of the monotypic *Megaleia* and five species of *Macropus*. Outstanding among graphic materials are three superb color plates depicting 15 examples of subspecies, sexual dimorphism, and pelage patterns. The primitive but efficient reproductive biology of kangaroos is carefully reviewed, as are details of behavior and movements, to prepare the reader for discussions of populations. The points are made that for kangaroos drought is perhaps the most effective regulator of numbers, that serious disease is almost unknown among them, and that their only significant predator is modern man.

Had the aboriginal Australian, who possessed the dog, succeeded in domesticating and herding one or several of the kangaroos, his history and progress, and likely that of fragile arid-land habitats of the continent, would possibly have been more inspiring. However, Australia was destined to be recorded as yet another instance of conquest by an indiscriminate Western livestock agriculture. The authors face the reality of vast rangelands depleted or turned to stony desert through mismanagement, with sometimes severe effects on populations of kangaroos, including annihilation. They build their case for a new order of things on the systematic interpretation of kangaroo biology and ecology and of pastoral practices. The conclusion that preferences and abundance of food are the chief factors in ecological separation of species of kangaroos appears to be well founded. Development of grazing lands has had a variable effect on kangaroos in different regions of Australia, bringing to mind parallels in responses by other grassland herbivores to similar land use patterns in the western United States. In New South Wales herding of sheep on scrub lands and grazing of cattle on the tall-grass plains have resulted in increase of the red kangaroo; but in northwest Australia the red species was eliminated by sheep and the euros increased enormously, only to be blamed by landholders for deterioration of the range. Direct competition between cattle and kangaroos is minimal except in times of drought, when kangaroos suffer first for lack of green feed. The red kangaroo, especially, requires rich land in order to thrive. This means settled land, hence its prominence and critical position as a species in dire need of proper management if it is to be exploited for a sustained yield of hides and meat, and not eliminated as a pest. Market hunting of kangaroos is thoroughly examined, and a route is threaded through the problem of balancing the harvest with progress of the population. Frith and Calaby are cautious in their pronouncements and make a plea for a broader view by stockmen to include the kangaroo in their estimates of range carrying capacity, in favor of improving total productivity.

This volume is more than an excellent account of kangaroo biology and ecology, it is an appeal for the application of wisdom in the belated preservation and management of an irreplaceable biota; moreover, it outlines with purpose, using the kangaroos as examples where knowledge has been attained, how this can and must be done.

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Geological Process

Chemical Weathering of the Silicate Minerals. F. C. LOUGHNAN. Elsevier, New York, 1969. x + 154 pp., illus. $10.50.

W. D. Keller in the *Principles of Chemical Weathering* (Lucas, Columbia, Missouri) wrote, "Chemical weathering is, indeed, the geological process most important to man." Chemical weathering is the primary process involved in the formation and destruction of fertile soils. There is an optimum amount of chemical weathering that will produce and maintain a fertile soil under given conditions; further weathering will decrease fertility but may increase the economic value of the soil by developing concentrations of such substances as clay, iron, aluminum, manganese, uranium, and phosphates.

Loughnan's book is timely and should