have been collected in the eastern Himalayas, some of which do have at least a superficial resemblance to Palomero Toluqueño. However, the collections correctly identified as Sikkim Primitive, a number of which have been grown and studied by this reviewer, differ markedly from Palomero Toluqueño in most plant, ear, and tassel characteristics. Furthermore, they appear not to have closely related counterparts among any of the described races of popcorn from the Western Hemisphere. This does not mean, of course, as has been implied by some Indian workers, that Sikkim Primitive was in Asia in the pre-Columbian era.

The criticisms notwithstanding, I consider this book an important contribution to maize literature. It is clearly written and beautifully illustrated. All students of maize, regardless of their specialty, will find in it much of interest. It should also interest ethnobotanists, economic botanists, and students concerned in any way with the evolution of cultivated plants.

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Thermoregulatory Mechanisms

Temperature Regulation in Mammals and Other Vertebrates. JOHN BLIGH. North-Holland, Amsterdam, and Elsevier, New York, 1973. xx, 436 pp., illus. $30.50. Frontiers in Biology, vol. 30.

The author's preface of this volume includes John Bunyan's apology at the beginning of *Pilgrim's Progress*, which notes that a modest volume was intended but something else emerged. The apology notwithstanding, most of Bligh's review and discussion is worthy of consideration. Bligh depends primarily upon control theory to expound the thermoregulatory mechanisms, treating previous and new data in the context of functional neuronal models. This is a novel approach, but a tenuous one because this type of representation is still largely conjectural.

The regulation of body temperature is a subject concerning which relatively little has been established as scientific fact. Discrete sensing and efferent mechanisms have been characterized to some extent, and these characterizations are sufficiently described in this volume. Complete understanding of thermoregulation, however, depends upon the study of regulatory mechanisms within a number of organ systems and, especially, of the interactions between these mechanisms. The interdependence of different organ systems receives some, but not enough, attention. The proper attention is given to the derivation of basic principles of thermoregulation. To this Bligh takes an eclectic approach, tending to discount established concepts when necessary and to give credibility to new ideas if they mesh with certain patterns.

The control theory viewpoint focuses attention on the relationships between sensory and motor activities and, in this volume, on postulated events within the regulator, which of necessity has been viewed as a black box. This regulator, after all, operates by comparing intensities or rates of input variables with idealized intensities or rates, directing appropriate signals to efferent end organs so that any error signal is minimized. Among the advantages of approaching thermoregulation by way of a working model such as Bligh has set up is the ease of presentation such a model allows. Pathways and interactions are easy to visualize when placed in flow diagram form. The major drawback is the conjectural nature of the model. To infer neuronal networks from single unit recordings or from administration of neurotransmitter substances is to make a great jump; there is no direct evidence that neurons within the hypothalamus are connected in the way depicted in this book. As Bligh himself is careful to note, his model "may be little more than a pretty piece of fiction based upon scraps of physiological evidence and a great deal of imagination." However, up to now, most discussion of thermoregulation has consisted of making comparisons between responses on a temporal basis, without identifying the important inputs to the regulatory center—that is, previous discussion has been largely descriptive in nature and has contributed little insight into the regulatory processes per se. Bligh's approach may help to place the descriptive approach in its proper bay.

Fully half the volume is devoted to relationships between sensory, integrator, and motor activity. The biophysics of energy exchanges between the animal and its environment is treated in a cursory manner, perhaps on the assumption that anyone who would choose to pick up this volume already has a good appreciation of these phenomena. Bligh's strong suit is the discussion and evaluation of sensory activities and their postulated effects within the central nervous system. He discusses nearly every contribution on these subjects prior to 1971 and attempts to put them into an orderly scheme. This is a difficult task, because a lack of proper controls and the use of pharmacological rather than physiological techniques have often confused issues. Especially provocative are chapters that discuss fever and unorthodox theories of thermoregulation. In the latter of these, Bligh elaborates somewhat on his two-tiered theory, which is based upon differential rates of sensory function and which proposes that there are two distinct thermoregulatory systems, one for fine and the other for coarse, broad-band control. It is an intriguing concept that may explain observations that have otherwise been difficult to account for. Less informative are the chapters on temperature regulation during exercise and on acclimatization to heat and cold. The former is devoid of useful quantitative information and is neglectful of circulatory dynamics. The latter is primarily concerned with cold acclimatization, also neglecting circulatory adjustments in heat acclimatization. The final few chapters, which deal with comparative thermoregulation, detract from the primary message, and the volume would have been tighter and more cohesive had they been omitted.

Bligh correctly admonishes himself along with the rest of us about our persistence in the use of "ancient" terminology. He reminds us that the widely adopted Système Internationale requires the use of joules in the place of calories as the standard energy term (how many of us think in terms of a 6278-kj-per-day diet?). There is no question that conversion to a universally standardized terminology, though it can be painful, is ultimately of great value. SI equivalents could have been included parenthetically so that we might begin adapting.

For the graduate student or researcher in environmental physiology, this is a thorough reference book which offers many stimulating ideas. Its ultimate value may be in the presentation of controversial models and concepts that require testing in the laboratory.

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