studies such as those of Lund included here have shown that the neurons residing in each cortical layer give rise to unique patterns of connections. This principle of lamination is examined also at the ultrastructural level, by Colonnier; each layer contains a unique complement of synaptic inputs, and the intrinsic and extrinsic origins of many of these inputs are now known. Not surprisingly, the uniqueness of each cortical layer is also reflected in its neurochemistry, as is discussed by Emson and Hunt. And functionally each layer of the visual cortex can be distinguished on the basis of the response properties of the neurons it contains. Just how such physiological properties might be constructed from the anatomy is the subject of Gilbert and Wiesel's contribution. The cortex can also be subdivided vertically from pial surface to white matter into a system of "columns." Neurons belonging to a given column all share the same functional property—"eye dominance," for example, in visual cortex. The anatomical basis for these particular columns and their development are considered in chapters by Rakic and by LeVay, Wiesel, and Hubel. Finally, cortex is organized topographically. Primary visual cortex, for example, contains an orderly map of the visual field, and, as is discussed by Cowey, this map is repeated (in a more or less orderly fashion) over and over again in nearby visual cortical areas.

In and of themselves, these principles of organization are not news. Columnar organization, for instance, was first proposed by Mountcastle in his 1957 study of the somatosensory cortex. (Sadly, no contribution from Mountcastle is included here, but his work is eloquently summarized in an introduction by Cowan.) Notions of lamination and topography date even earlier. What is news is that the list of cerebral cortical areas now known to conform to these principles is impressive indeed, as exemplified by the numerous fine and exhaustive studies included in this volume. (Studies of auditory cortex have, regrettably, been omitted.)

Just how to piece together from an appreciation of the organization of the cerebral cortex at the structural level an understanding of its function is by no means clear. The problem is bravely attacked in the book's last two sections, one dealing with higher functions of the cerebral cortex and the other with models of cerebral cortical function. At this point, there are no simple answers to be had and no broad conclusions to be drawn. Nevertheless, it is encouraging to note that efforts are in progress to elaborate theoretical frameworks within which this ultimate question might be answered. But a theoretical framework alone is not enough. Perhaps some of the techniques developed recently (and not considered in this volume) for the study of human brain function by means of cerebral blood flow monitoring will be sufficient to bridge the gap between our understanding of local cortical organization and global cerebral cortical function. Or perhaps the wish articulated by the editors in their preface will be granted: that this collection, certainly thought-provoking and timely, will "stimulate and call forth creative new approaches to the study of the neural substrates of behavior."

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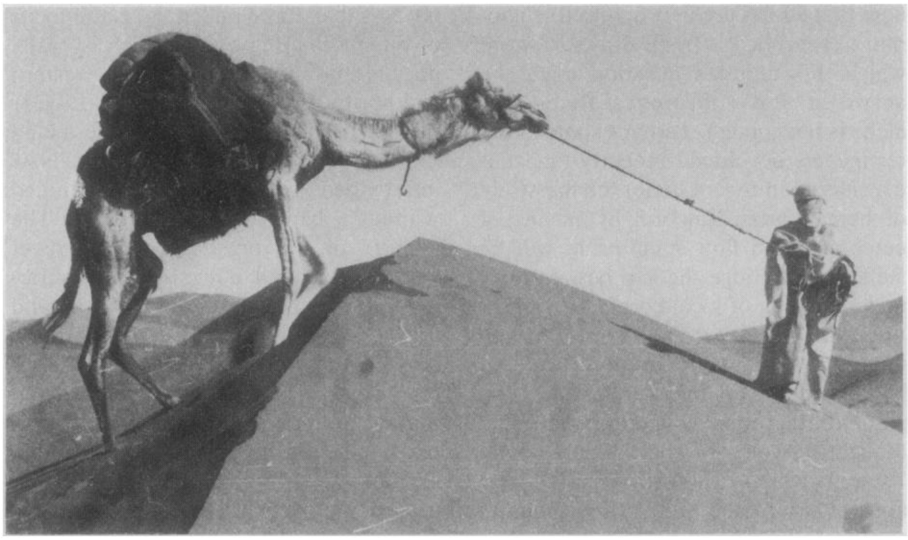
Desert Domesticates

The Camel. Its Evolution, Ecology, Behavior, and Relationship to Man. HILDE GAUTHIER-PILTERS and ANNE INNIS DAGG. University of Chicago Press, Chicago, 1981. xii, 208 pp., illus., + plates. $26.

Targets of droll anecdote and poetic allusion, the Camelidae grace the earth with only six species. These species, descendants of Pleistocene emigrants to Asia and South America, are the only remnants of a diverse assemblage of extinct North American camelids that ranged from gazelle-like to giraffe-like forms. The dromedary, domesticated for not less than three millennia, is the focus of this fascinating book, which is based on intermittent research in the western and northwestern Sahara over a 19-year period. In this seemingly boundless land the survival of nomads and camels is intertwined; so neither can be studied without a hard look at the other. The authors of the present book achieve, with clarity, their objectives of describing the camel in its natural habitat and drawing attention to the camel herder's role in desert ecology. The first part of the book considers the camel's evolution, ecology, and behavior and the second considers its relationship to man. Gauthier-Pilters and Dagg, authorities on camels and ungulate locomotion, have successfully synthesized their own findings and an extensive literature. The book has a bibliography of over 500 items, nearly half of which are cited in the text, and it is illustrated with 68 excellent photographs.

The primary habitat of the dromedary is the Sahara desert, "the largest, hottest, driest desert in the world." This is a land of burning winds, sporadic rainfall, and ground temperatures that reach 60°C. The authors' description of Saharan climate, relief, and plant cover will do much to enlighten the stereotyped image the film industry has given most Western readers. Few ungulates are able to exploit the salty, toxic, or thorny plants of the desert, but the camel's water economy allows it to penetrate remote waterless pastures, where it sparingly samples a wide range of foods. Some halophytes may constitute up to 35 percent of the total food intake, and together with dry grass salty plants form a well-balanced regimen. Toxic plants

"Camel feeding on an *Acacia* twig with long thorns." Camels "often first grasp the vegetation between their long, hairy prehensile lips, the upper two halves of which are separated and move independently. . . . The camel may either draw off leaves from a branch or clip off an entire twig, individual fruit, or flowers." [From *The Camel*]



"A loaded camel climbing up a steep slope is helped if its head is stretched forward." In the camel the "main force of locomotion is in the forequarters, rather than, as in the horse, the hindquarters, so that when a camel comes up to a hill it 'pulls' its body up slowly, instead of accelerating and pushing itself up quickly as a horse does." [From *The Camel*]

are usually avoided, though nonpoisonous parts may be eaten. The camel's ability to identify poisonous foods is apparently conditioned by learning. On unfamiliar pastures, for example, camels sometimes confuse toxic species with similar but nonpoisonous ones they are used to. When this happens nomads rely on a variety of folk cures to alleviate poisoning.

Like other polygynous ungulates camels exhibit an annual cycle of social organization. Stable groups averaging 11 head forage over an expansive home area. Management varies regionally, but in all cases camels depend on humans to be watered, at least during the summer when allowed to roam freely. The seminomadic Tibbu and Chaanba turn their camels loose when they tend seasonal crops, but the milk-thriving Reguibat are pure nomads who maintain herds throughout the year.

Contemporary and historical factors encourage nomads to become sedentary and reject time-tested values of the pastoral lifestyle. The authors argue convincingly that camels are a vital and economic means for gently reaping assets from low-productivity lands where other livestock cannot endure and cultivation is not a current option. Meat, milk, and wool are among the marketable resources into which only camels can convert the desert fodder. Even transmission belts have been made from camel hair. Western Saharan arid lands can support more than a million people, but water is the key to their exploitation. The future of the nomadic economy depends greatly on relatively inexpensive improvements to desert oglats and wells, a topic to which the authors devote thoughtfı attention. This fine contribution has value for biologists, historians, anthropologists, and conservationists.

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Tropical Trees

Age and Growth Rate of Tropical Trees. New Directions for Research. Proceedings of a workshop, Petersham, Mass., Apr. 1980. F. HERBERT BORMANN and GRAEME BERLYN, Eds. Yale University School of Forestry and Environmental Studies, New Haven, Conn., 1981. iv, 138 pp., illus. Paper, $6.95. Yale University School of Forestry and Environmental Studies Bulletin No. 94.

By now most scientists, conservationists, and concerned citizens are aware that species-rich tropical forest habitats are fast being destroyed by humans. Of more direct concern to Third World countries are the decreased water supplies, flooding, erosion, and soil infertility that result from the disruption of this complex ecosystem. If we are to utilize tropical forests without simultaneously destroying them, we must understand the natural biological mechanism for prolonged, steady-state productivity of the forest. To do this, we must conserve intact and healthy portions of forests for study and use by future generations.

Unfortunately, tropical forests are among the least-known forest ecosystems in the world. Our lack of understanding is, in large part, due to our inability to determine the ages and growth rates of tropical trees accurately. In most tropical trees that are evergreen or only briefly leafless, defined annual growth rings are absent. Even those trees growing under seasonally dry conditions often lack rings. Thus, neither individual trees nor their population can be aged. Size is an unreliable indicator of the age of a tree, since growth rates vary widely under different conditions. In the tropics there is nothing equivalent to the elegant dendrochronological studies carried out with archeological wood in North America or Europe. This ignorance of the age of trees in a mature rain forest, for example, critically limits any attempt to utilize similar forests on a sustained-yield basis. The prediction of long-term forest productivity is intelligent guesswork at best.

The present publication is the proceedings of a workshop on the subject in which 27 specialists in wood structure, ecology, forestry, and tree biology participated. The book consists of general introductions to some of the problems and a series of seven group reports on the present state of knowledge in a variety of fields that tackle them. Recommendations for the future direction of research conclude the proceedings. All sections are up to date and concise; several are written with the field and laboratory researcher in mind and indicate equipment needs. The relatively short lists of references for each topic are a sad commentary on our present state of knowledge of tropical trees.

The most optimistic report is on wood anatomy (A. Fahn *et al.*). Many tropical trees do form growth rings or have subtle variations in wood structure that might be useful in dating. It is still necessary to correlate such structural features with long-term (periods of five years or longer) growth observations to verify regular periodicity. Yet many tropical trees have extremely uniform wood without any evidence of seasonal differences that is visible with the light microscope.

The remaining reports offer other ways of attacking the problem. Changes in wood chemisry (T. Swain *et al.*) occur as wood cells age and may be of value for a rough determination of age. A variety of radioisotopes (M. Stuiver *et al.*) are incorporated into wood. The 1964 peak in ^{14}C found in wood formed during the years of atmospheric nuclear bomb testing may serve as a marker. However, such analyis is expensive and impractical for routine dating. The possibilities and problems of relating variations in wood anatomy to weather changes are covered