The contributors to this volume of proceedings from a symposium of the Geological Society of America focus on "the role played by local glaciers during the growth and subsequent dissipation of the principal late Wisconsinan" ice sheet, coincidentally vindicating the views of Ells and Chalmers. The contributions describe geomorphic relationships in representative areas at scales that range from a multiple-till exposure on Nash Stream in northern New Hampshire (Koteff and Pessl) to moraines north of the St. Lawrence River (Dubois and Dionne).

Most of the papers focus on the style of retreat, each seeming to tighten our view of Laurentide ice wastage. According to the current model, rapid but not uninterrupted recession of the marine-based ice margin across the coastal belt of southern Maine occurred about 13,500 years before the present. Topography controlled the development of an ice stream with minimal basal shear and a low surface gradient draining northeast through the Gulf of St. Lawrence and Cabot Strait. Subsequent retreat of a calving bay southwestward exposed the St. Lawrence Valley to inundation. While the Laurentide ice border continued in northward retreat, ice flowed north toward the Champlain Sea from residual masses in the Appalachians of Quebec and Maine.

A contribution by a group at the University of Maine (Hughes *et al.*) takes a more esoteric approach, distinguishing between first- and second-order glacial features. The former are large, involving, for instance, concentric zones of relative erosional and depositional effectiveness. Reconstruction of Pleistocene ice sheets on the basis of first-order features relates to the "steady-state flow regime" and maximum extent of glaciation. In contrast, moraines, drumlins, and eskers—second-order features examined in studies in this volume—relate to conditions during deglaciation. Though Hughes *et al.* endorse the model developed largely by Canadian geologists, they nonetheless continue the dispute concerning Laurentide ice dynamics, asserting that "over-reliance on second-order glacial geology is at the root of the dispute."

In the closing chapter, Bonnichsen *et al.* direct attention from the style and causes of deglaciation to its implications for humans migrating into the newly deglaciated land.

The volume is well illustrated, and it is edited to the usual high standards of G.S.A. Special Papers. Sketch maps and line drawings in each chapter facilitate the location of place names, but a map showing all report areas in relation to each other would have been useful.

Little overlap exists between the volume and an earlier symposium volume, *Late Wisconsinan Glaciation of New England* edited by Larson and Stone (Kendall/Hunt, 1981). The geographic focuses and the thrusts of the two volumes are complementary. Only one paper in the earlier volume even takes note of the model that is essentially the theme of this one. Together, however, the two volumes go a long way toward summarizing Quaternary research of recent decades in glaciated northeastern North America. The two belong side by side on the library shelves of all who study the Quaternary geology of North America.

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Antarctica and Its Biota

Antarctic Ecology. R. M. LAWS, Ed. Academic Press, Orlando, Fla., 1984. In two volumes. Vol. 1, xviii pp. & pp. 1–344, illus., + index. $55. Vol. 2, xviii pp. + pp. 345–850, illus., + index. $75.

"Ecology is a youthful science and nowhere so young as in the Antarctic." So begins the preface of this two-volume review of Antarctic ecology. Actually, ecology is relatively an old science and perhaps nowhere so old as in Antarctica, where the early expeditions included the leading naturalists of their times. Indeed, in no other area is the past of the science so visible day to day as in Antarctica. What the editor probably means is that ecology in general, and antarctic ecology especially, have been slow to mature into a science based on rigorous testing of relevant and interesting hypotheses. These two volumes, which constitute the most complete review of the subject ever written, are certain to accelerate the maturation of antarctic ecology.

The first volume has five chapters, all concerned with non-marine habitats. The first chapter is a remarkable attempt to integrate geology, climate (including high-altitude jets, winds, and microclimates), and soils. The second chapter, which is the most complete review in the volume, deals with plant biology. The third chapter attempts to cover microbiology, invertebrates, and ecosystems, though, partly because the literature has few innovative examples, it falls short on the last. The other two chapters deal with introduced mammals and inland waters. The discussion of introduced mammals offers interesting ecological insights into the community effects of exotic grazers, and the discussion of lakes is especially useful for its efforts to compare patterns with similar situations in the Arctic. Though some ecologists might wish for a more evolutionary perspective, the syntheses provided by these chapters are by far the most complete I have seen on their subjects.

The chapters in volume 2, dealing largely with marine habitats, differ somewhat in character. First, they tend to be more specialized, focusing on somewhat narrower topics. Second, the collection is particularly valuable because several of the papers integrate and make available a large amount of obscure literature. The short paper on physical oceanography offers a summary of large-scale physical patterns. Because most antarctic coastal marine ecology is done in relatively small areas, field scientists could have benefited from more discussion of regional and small-scale patterns that drive the coastal systems. A chapter on the marine flora covers a great deal of material, from intertidal lichens and algae to large subtidal algae to phytoplankton, the treatment of the last taking into account a large and sometimes conflicting literature. The chapter on the benthos is a solid review of the literature with a welcome comparative and evolutionary perspective. Chapters on zooplankton, fish, and marine interactions are workmanlike reviews of a diverse international literature. These chapters are particularly important in light of the expanding krill fishery. The most outstanding chapter is the one on seabirds by J. P. Croxall. It may be the best paper on seabirds ever written, for it integrates zoogeography, energetics, food webs, foraging, and breeding behavior into a remarkably complete evolutionary perspective of a multitude of populations foraging in the same habitat. The chapter by Laws on seals is also unique in its integration of a tremendous amount of little-known literature, which may be especially available to Laws because of his far-ranging biopolitical activities. The chapter on whales similarly takes advantage of a difficult and obscure literature from the whaling industry to synthesize an exceptionally complete review of antarctic cetaceans. Unfortunately it does not attempt the ecosystem and evolutionary perspective of the seabird and seal chapters. Finally, because of the growing politicization of the Antarctic and Southern Ocean, the articulate and carefully reasoned chapter on conserva-

tion that ends the volume may be the most important contribution of the work.

In toto, this is an encyclopedic literature review in which the biology is often well integrated with physical, paleontological, geochemical, and climatological processes. Laws and the authors have been immensely successful with their objectives. I wish that Laws had included a chapter on Holocene geology, because coastal biologists must be cognizant of recent patterns of glaciation, local isostasy, and sea-ice and sea-level fluxes. Also useful might have been a biogeographical chapter addressing the age and geographical sources of marine species, both planktonic and benthic, as is done for terrestrial plants in volume 1. Missing also is an account of the rich history of Antarctic ecology. The accomplishments of the early naturalists under ghastly conditions represent some of the highest points in our literature—who among the readers of these volumes has not thrilled at Cherry-Garrard's rendition of E. A. Wilson's activities in *The Worst Journey in the World*? A brief history of the accomplishments of the early naturalists and the *Discovery* expeditions would have added an important dimension to this work. Finally, for the large number of antarctic aficionados, especially those working on the various large international Southern Ocean projects, there will be an inevitable sense of *déjà vu*, for several of the authors in these volumes, especially T. D. Foster, I. Everson, and Laws, have written many quite similar reviews on their subjects.

The publication was conceived by Academic Press as an updating of their 1970 book of the same title, which was the proceedings of the 1968 Second Symposium on Antarctic Research. A comparison with that and the several subsequent symposiums that have been held is unavoidable. Laws notes that the present treatment of antarctic ecology has the "advantage of planning a more balanced account" than proceedings volumes, which he claims are unplanned, with their contents depending on what happens to be offered. Missing by design, however, is the international flair, the zest, and the novel thinking (often associated with graduate students) of the symposiums. There is a tendency to look to reviews to point in new research directions, but in most of these chapters the emphasis is descriptive and the research suggestions that are offered tend to be in the direction of filling in of holes in the factual tapestry rather than the deductive leaps and bold conjectures important in science.

These quibbles notwithstanding, this is an excellent and important publication that will be of great use for many years to come.

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Startle Circuits

Neural Mechanisms of Startle Behavior. ROBERT C. EATON, Ed. Plenum, New York, 1984. xx, 377 pp., illus. $49.50.

In contemporary neurobiology there is a keen and widespread interest in relating neurons and neural networks to behavior. The ultimate goal of this endeavor is to try to uncover common neural mechanisms that can teach us some of the general principles that underlie the neural organization of behavior. But how might we search for general principles among the almost bewildering number of animals, behaviors, and nervous systems that it is possible to analyze? One approach is exemplified by *Neural Mechanisms of Startle Behavior*. Startle behaviors are short-latency, fast motor acts that occur in response to stimuli having a sudden or an unexpected onset. What emerges from the book is that startle circuits can provide an extremely useful comparative vantage point for examining the mechanisms by which phylogenetically diverse nervous systems have solved a fundamental problem in adaptive behavior: the need to respond rapidly to potentially threatening stimuli. The contributors to the volume study animals ranging from jellyfish to rodents and use approaches ranging from cellular neurophysiology and anatomy to neurogenetics and neuropharmacology. But because they all focus on the elements common to startle circuits, some important themes emerge about properties of neural circuits involved in the initiation of behavior.

One of the most pervasive themes concerns the role of giant fibers in mediating startle and rapid escape responses. As is clear from Bullock's lucid introductory chapter, it has long been appreciated that large-diameter fibers contribute to startle and escape in a wide variety of species. However, the view that all giant fibers are functionally alike and simply act to initiate behavior (the neural equivalent of a starter's pistol at a track meet) is quickly dispelled by several enlightening examples. Ritzmann discusses compelling evidence in the cockroach that the ventral giant interneurons provide the principal initiation signal for most escape responses and that the dorsal giant interneurons provide a bifunctional pathway that, in response to wind stimuli, triggers directed escape running when the legs are in contact with the ground and flight when they are not. Krasne and Wine show clearly that in the crayfish the medial giants, which have a rostral receptive field, trigger a tail flip that drives the animal backward away from the rostral threat whereas the lateral giants, which have a caudal receptive field, trigger a response that lifts the animal and pivots it forward, away from the eliciting stimulus. Similarly, Drewes describes how in earthworms the difference in receptive fields for the medial giant fiber (anterior-sensitive) and the lateral giant fiber (posterior-sensitive) can explain differential rapid withdrawal responses to directed stimuli. Further important insights into the organization of giant fiber systems come from Eaton and Hackett's excellent chapter describing in detail the morphology, physiology, connectivity, and function of the Mauthner cell in teleost fishes. Finally, Wyman and colleagues describe a series of elegant studies of the effects of mutations on neural connectivity in a well-defined startle circuit responsible for triggering jump responses in the giant fiber system of *Drosophila*. But giant fibers are clearly not the whole story. In many species (fish and crayfish to name only two) escape responses that are not mediated by giant fibers are clearly possible. At least in crayfish, the functional significance of giant and non-giant responses reflects the tradeoff between speed on the one hand and control of direction on the other.

A second theme concerns the modern application of the "command neuron" concept. Two of the most widely accepted examples of this concept, the Mauthner cell and the crayfish lateral giants, are discussed in detail in several chapters (Krasne and Wine provide a particularly insightful commentary). Two important ideas that can be distilled from these chapters are, first, that commands are delivered and processed in a behavioral context that can ultimately sculpt the final motor output and, second, that commands are not simple "decision switches" that always produce all-or-none behavioral responses. Bennett provides several thoughtful examples that illustrate these ideas. He points out that earthworm shortening is dependent upon the firing frequency of giant neurons, that crayfish tail flip responses that are evoked by giant fibers are sup-