electrical manufacturers under Coffin's control.

During this long, critical stretch of the narrative, Thomson drops entirely out of the story. When he reappears, with the merger complete and Coffin in charge of a single organization that would soon be known simply as General Electric, his role had clearly diminished further. GE soon moved its corporate offices and most of its operations to Schenectady, but Thomson stayed behind in Lynn. The new organizational chart showed him as one of several managers who supervised groups of product engineers, all of whom reported ultimately to the person who previously had supervised the manufacturing works at Thomson-Houston. Thomson soon even lost his place as the most "scientific" member of GE's staff to Charles Steinmetz. While Thomson increasingly focused his energies outside GE, most notably in his activities with the newly formed American Institute of Electrical Engineers, Steinmetz cultivated an integral position within the firm by providing calculations for its engineers who were busily installing electric power systems in the field.

Americans came to enjoy the benefits of those power systems more rapidly than any other people of the time, and American firms garnered more than their share of profits in the international market for electric power. By paying attention not only to the inventors but to the organizational context in which they functioned, Carlson has shown us why. In the process, he has produced a book rich with insights into the process of innovation.

Steven W. Usselman
Department of History,
University of North Carolina,
Charlotte, NC 28223

■

Dining Respectably

Cannibalism. Ecology and Evolution among Diverse Taxa. MARK A. ELGAR and BERNARD J. CRESPI, Eds. Oxford University Press, New York, 1992. viii, 361 pp., illus. $75.

In the 1960s and '70s, refinements of natural selection theory led most biologists to realize that phenotypic traits, including behavior patterns, evolve because of net benefit to the individual's inclusive fitness. One consequence of this paradigm shift away from classical "group selection" (the view that traits evolve mainly for the good of the population or species) was that sporadically reported cases of vile or unsavory behaviors performed by animals (such as rape, slavery, infanticide, mate-desertion, and cannibalism) could not simply be assumed to be pathological or aberrant any more. Even actions such as these might have evolved if they typically conferred reproductive advantages on their practitioners. One could no longer seek comfort in the meager records (many such behaviors are inherently rare and hard to witness) or dismiss them airily as mere byproducts of captivity.

Modern selection theory thus provided two key legitimizations for topics like cannibalism. First, the few extant anecdotes could be retrofitted with plausible and testable functions, salvaging the topic as scientific. Second, workers were inspired to search systematically for additional examples and twists. This led to exponential growth on several fronts. Ecological predictions began to emerge, specifying the contexts in which these behaviors should be found. Eventually, reviews began to appear. The current volume can be viewed, therefore, as the formal rite of passage for the fascinating topic of cannibalism as a very respectable area in evolutionary biology.

Fifteen review chapters by 17 scientists make it abundantly clear that there is nothing particularly astonishing or freakish about the ingestion of conspecific tissue. Such habits have evolved repeatedly as a solution to various problems, often (but not always) involving food shortages. On the other hand, cannibalism is not for everyone: it has special costs. Conspecifics are far more likely than alternative prey types to carry the parasites to which the diner is vulnerable. Then too, there are at least three categories of conspecifics (genetic kin, potential mates, and flock-mates) that are often more valuable to an individual as living entities than as meals. Finally, some conspecifics are more easily killed and eaten than others.

A predictive framework emerges: *ceteris paribus*, cannibalism should be expected in food-poor contexts, preferably involving helpless unrelated neonates, perhaps of the cannibal's own gender. The exceptions are many and often the most edifying cases. For example, cannibalism of close genetic relatives is quite common in various insects where mothers produce extra eggs whose sole function is to nourish siblings (chapters by Crespi and Kukuk). Sometimes these "trophic eggs" are not viable (unfertilized); otherwise siblings have a developmental race that determines who becomes the diner and who the dinner. From the parental perspective, producing extra offspring that will serve as future meals for others can be a means of converting available and efficiently harvested nutrients into a stable form (eggs) that will not spoil before being ingested by the first-hatching progeny.

At first glance, consuming a viable full sib (which carries copies of half of the cannibal's own alleles) seems maladaptive. Many factors can tip the balance. For example, the sacrificed brood mate may have had a vanishingly small chance of reaching reproductive maturity. In one Swedish land snail, Bruno Baur reports that average egg survivorship is so low (fewer than 1% ever become juveniles) and benefits for eating a conspecific egg so high (the cannibal's shell diameter enlarges 25% in three days if it consumes just one egg, a feat of growth that otherwise takes 21 days) that the cannibal's likelihood of reaching adulthood is increased by about 40%. For this species the balance sheet suggests that relatedness to the victim is immaterial. Full sib, half sib, or alien, an egg is more valuable as a food item. This helps explain why these snails show no discrimination by degree of kinship.

Similarly, Martha Crump notes that desert tadpoles are often under great pressure to escape quickly from an evaporating natal pool; rich meals of animal protein can make the difference. In several amphibians spectacular developmental polymorphisms arise, wherein some individuals acquire bizarre cannibal structures (among them a greatly enlarged head, hypertrophied mouthparts) and others remain omnivorous. If the pool vanishes, fast-growing cannibal-morph individuals are more likely to have metamorphosed; otherwise, the larger lipid reserves of the (uneaten) omnivores apparently confer compensating advantages through larger adult body size.

For various fishes, the solo parent tending a fertilized egg mass cannot leave to forage, so it sustains itself by eating some of its own brood (chapters by G. Fitzgerald, F. Whoriskey, and C. Sargent). This "filial cannibalism" satisfies parental needs while greatly benefitting all siblings not consumed (they receive continuous guarding). If the parent finds itself holding a clutch that is "too small," below some threshold, it may achieve higher reproductive success by eating all current eggs (recouping part of a bad investment) and starting anew with a larger family. Similar loss-cutting measures are described for birds, mammals, and plants in other chapters.

Sexual cannibalism has evolved in some insects, spiders, and their allies, when mating females consume courting males. Mark Elgar draws a distinction between taxa where the cannibalism occurs before the mating act itself (a uniquely effective form of female mate rejection) and those practicing it afterward. Postmating cannibalism accommodates the tantalizing possibility that males are suicidal collaborators, willingly providing paternal investment not unlike the fatal conversion of body tissue to eggs by semelparous female salmon. In the spider *Argiope aemura*, the male inseminates the female once, inverts himself to facilitate her initial feeding on his abdomen, moves away briefly

Vignettes: Remembered Revelries

At the holiday season, the Guggenheim lab [at Caltech] always hosted a lively Christmas party. Santa Claus never failed to grace these happy affairs, and [1942] passed true to form. At the designated moment, to the delight of adults as well as children, out stepped a marvelous St. Nicholas—stocky, round-faced, animated, and genial. Every year Santa gave away his identity when he spoke. Out came the soft, deep Hungarian sentences and accented "Ho-Ho-Ho"'s. A Jack Daniel's, a cigar, and a wayward hand on an attractive female partygoer removed any doubt about the man beneath the white beard and red suit.

—*Michael H. Gorn*, in *The Universal Man: Theodore von Kármán's Life in Aeronautics* (Smithsonian Institution Press)

By consensus, the social event that best personified [the] Anglo-American spirit of cooperation at Los Alamos came on Saturday, September 22, 1945. That night the British Mission members put on a party to celebrate "the birth of the Atomic Era." . . . Invitations were engraved. Guests arrived in "formal" attire, many of the women in white gloves. A "footman" announced the arrival of each guest . . . . The Mission wives had worked for weeks at their "most secret" (British "top secret") preparation. . . . Winifred Moon's dessert of trifle became an object of considerable interest to the Americans, most of whom had never seen it before. Several hid theirs in the long table drawers, to be discovered much later.

—*Ferenc Morton Szasz*, in *British Scientists and the Manhattan Project: The Los Alamos Years* (St. Martin's Press)

(already partially mutilated), then returns, mates a second time, and is inevitably eaten. What he gains for his compliance is unknown.

In addition to summarizing a burgeoning literature on the taxonomic diversity and evolutionary significance of intraspecific predation, the collected reviews also address such topics as the proximate cues underlying cannibalistic acts (in rodents; reviewed by R. Elwood), the genetic basis for cannibalism (in flour bugs; L. Stevens), and how population and community structure are likely to be affected by such dynamics (Q. Dong and G. Polis).

Douglas Mock
Department of Zoology, University of Oklahoma, Norman, OK 73019

■

Complexities of Stress

Perturbing the Organism. The Biology of Stressful Experience. HERBERT WEINER. University of Chicago Press, Chicago, IL, 1992. xvi, 357 pp., illus. $35. John D. and Catherine T. MacArthur Foundation Series on Mental Health and Development.

What is stress? In this examination of the subject Weiner rejects the constructs of Hans Selye, Walter B. Cannon, and other students of the responses to either physical or psychological hard knocks as unrealistic. With eclectic views and logic, he proposes, instead, a new Darwinian taxonomy that develops the notion of stressful experiences —categorized according to cause as due to external (natural or man-made) events such as earthquakes or wars or to personal events (affecting mainly an individual) such as bereavement—as "potential or actual threat[s] or challenge[s] to the integrity, survival, and reproduction of the organism." Most people have sufficient resources and coping skills to deal with these life experiences through anticipation, prevention, avoidance, or mastery of the stress-producing events. Others, less fit, may sink into "ill health" or even overt disease. Unfortunately, as Weiner points out, it is usually only the latter category of people whose responses to stressful experiences are studied in detail. Similarly, studies of animals usually have been designed in a way that does not allow behavioral responses to the administered threats and challenges. Weiner believes that these limitations in the way stress has been studied have led to the conclusion, particularly espoused by Selye, that stressful experiences induce nonspecific responses. He doubts the existence of general, nonspecific responses to specific stimuli. Nonetheless, he seems to agree with Selye that there is a general syndrome of ill health, manifested by disturbances in food intake, sexual desire, digestion, elimination, sleep, respiration, and thermoregulation, that may be exhibited by individuals with many different acute and chronic diseases or with no demonstrable disease.

After presentation of this new taxonomy and a historical account of the development of the notion of stress from the point of view of the physician, physiologist, and behaviorist, the midsection (and heart) of the book pleads for the compleat examination of stressful experiences and total (behavioral and physiological) responses of the individual to them. Weiner concludes that there is only weak evidence that poor individual responses to stressful experiences result directly in ill health or disease. Nonetheless, there are syndromes of ill health (posttraumatic stress disorders, hyperventilation, functional bowel, and musculoskeletal syndromes, sleep disorders) that may occur as a consequence of a multifactorial mix of risk factors, involving genetic make-up and past experience as well as the specific stressful experience. Moreover, results of animal studies (primarily of rats) show clearly that genetic make-up, neonatal stress, social rank, and degree of control clearly affect responses of animals to new experiences and may affect the development of disease.

The final, and least successful, portion of the book leaps, with occasional misconceptions, through the recent understanding of parallel processing in the nervous system, signaling at the genetic, cellular, organ, and organismal levels as revealing great complexity as well as specificity in the responses to stimuli, and signaling molecules that are common across communications systems—nervous, neuroendocrine, endocrine, and immune systems—of the organism and may direct a variety of responses. As a promising development, Weiner hints that the nonlinear mathematics of chaos theory may be applicable to the understanding of breakdowns that occur in maintenance of the stable, or unstable, rhythmic oscillations of the many controlled variables in the body. Each of these recent scientific developments is given superfical treatment that serves only to suggest further reading on the part of the serious student of the topic.

Overall, Weiner's book presents a philosophical examination of life and mechanisms of adaptation rather than a new framework in which to view stress. His efforts to provide a new taxonomy of stressful experience are not obviously useful. If adopted by basic scientists, his insistence that the response of each individual to stressful experience is unique would eliminate several fields of study that have been productively based on the idea that generalizations can be drawn from responses of groups of animals subjected to specified stressors. Nonetheless, the book