providing deep insight. McClintock's powers derived from reasoning so well developed that the therefores and QEDs of her papers and conversations left others straining to catch up. Could it be that the information available from manipulating maize chromosomes and studying effects on kernel and plant development was simply underestimated by those who decided the system had outlived its usefulness? Even today, maize chromosomes remain arguably the best material for the analysis of heterochromatic chromosome regions, a prime residence of transposable elements. Could it be that to such a gifted mind knowledge of the emergent properties of the biological world's higher organizational levels—the plant galls and the patterns on beetles' wings—provided valuable insights into its lower levels, rather than just vice versa? Perhaps, to those recently entering biology, to those working primarily at a single level, or to those still recovering from self-inflicted wounds with Occam's razor, this could seem like vitalism resurgent.

Barbara McClintock's life and the issues she addressed are too large to be fully encompassed by this volume. But it is a pure pleasure for anyone interested in the history of genetics and the life of one of its greatest exponents. James Shapiro suggests that McClintock may eventually be seen as the "central figure in 20th century biology." Perhaps Allan Campbell best summarizes the lessons we can learn from her life: "Throughout her career she has shown that true originality has no need to fear competition, that a first-rate intellect can set its own criteria for self-esteem, and that the joy of discovery can be given precedence over all else."

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Insects Recaptured

The Treatise on Invertebrate Paleontology. Part R, Arthropoda 4. Vols. 3 and 4, Superclass Hexapoda. F. M. CARPENTER. Geological Society of America, Boulder, CO (distributor), and University of Kansas, Lawrence, 1992. xxiv, 655 pp., illus. $87.50.

Insects are the most abundant animals on earth, in terms both of species and of individuals. About a million extant species have been described, but students of tropical forest canopies are finding so many previously unknown species that they suggest that there may be as many as 30 million species when all have been described. One estimate of the number of individuals present at one point in time puts it at 10^{18}. Study of the evolution of this exceedingly successful group of organisms has challenged biologists for many years. Unfortunately, the fossil record is not as helpful as we would like it to be. For most animal phyla (such as the Chordata and Mollusca) at least a third of the total known species are represented as fossils, but for insects the figure is more like 1 percent. Insects do not occur in marine sediments, and their delicate forms are preserved only in certain fine-grained terrestrial sediments and in amber—and even then often only as tantalizing fragments.

Nevertheless there is much to be learned from Frank M. Carpenter's long-awaited two volumes on Hexapoda in the *Treatise on Invertebrate Paleontology*. Carpenter's first paper on fossil insects was published in 1928, his latest in 1992—a span of 64 years. He explains that teaching and administrative duties prevented him from devoting full time to this project until he retired in 1974. We may feel fortunate that he has enjoyed such a long retirement, for the labor of synthesizing the scattered literature was enormous, and there is no one else who could have done it and done it so well. A great deal of research on fossil insects has been conducted in Russia, and having the results of this research made available to those of us who do not read Russian is a special reward from these volumes. All groups of insects (and the few non-insectan hexapods) that are represented in the fossil record are reviewed, although the Blattaria (cockroaches) are not covered as to families and genera, in deference to the ongoing studies of Jörg Schneider on the rich fossil record of that group.

Fifty-five orders of insects known only from fossils have been described, many of these on the basis of small fragments. Carpenter reduces these to ten, either by placing taxa in other, more inclusive orders or by simply listing them as "order unknown." Eleven orders were already present in the Upper Carboniferous; most were already fully winged, and two are still with us (mayflies and cockroaches). Yet the Lower Carboniferous is a void, and the Devonian contains only a few fragments of springtails (wingless hexapods, not here considered insects). Much obviously occurred in the Lower Carboniferous, including the origin of wings. Insects were on the wing long before birds and bats, and they are the only organisms that did not sacrifice their forelimbs when they acquired flight (aside, some wag has said, from angels). Carpenter briefly reviews some of the hypotheses that have been proposed concerning the origin of wings, but the secrets remain locked in the Lower Carboniferous.

For persons not well acquainted with the insect fossil record, there are many surprises in these volumes. Who would have supposed that the Mecoptera (scorpion flies), now a minor group, were represented by 24 families in the Mesozoic? Or that the Psocoptera (book and bark lice), hardly a significant component of contemporary ecosystems, had a diverse assemblage in the Permian (20 genera in seven families)? The Palaeodictyoptera, an order of over 100 genera occurring in the late Paleozoic, all possessed stout beaks that they may have used to extract juices from Cordaitales (forerunners of modern conifers). The Titanoptera had large stridulatory areas on their wings; they were large insects, and one can imagine *Mesotitan giganteus* resounding through Triassic forests, long before there were birds to join in the chorus. Many, but not all, early groups of insects were large, one of the largest being a dragonfly-like insect with a wingspan of 70 centimeters. Persons addicted to attributing the demise of the dinosaurs to a comet from space at the end of the Cretaceous will find little evidence to support their beliefs here; many groups of insects flourished and expanded through the Cretaceous-Tertiary interface.

Special bonuses in these volumes include a preliminary section on nomenclature by the editor of the *Treatise*, Roger Kaesler, and several useful stratigraphic range charts. Many genera are illustrated by line drawings, and there are several excellent photographs, taken by the author. Altogether these are extremely useful volumes that will not be rivaled for many years to come.

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Progress in Physiology

A History of Gastric Secretion and Digestion. Experimental Studies to 1975. HORACE W. DAVENPORT. Oxford University Press, New York, 1992. xviii, 414 pp., illus. $75.

Gastric secretion and digestion haven't been the same since the farmer's son from Lebanon, Connecticut, set out from home with a new mare and a hundred dollars. Who cares why? Horace W. Davenport, one of the deans of gastrointestinal physiology. Davenport, who occupied the