more than a decade. Now Miyai, Kiritani, and Nakasuji explain the key details of this work in a clear and coherent retrospective, pointing out the weaknesses as well as the strengths of their approach. Most important, they indicate where new work should lead. Other classical, long-term studies of virus diseases such as barley yellow dwarf (R. T. Plumb) and beet yellows (G. D. Heathcote) are reviewed in the context of predicting disease spread. In the case of beet yellows, a scheme that emphasizes simple measures of winter severity has provided surprisingly accurate predictions of regional disease severity in Britain. In contrast, the most recent models of the aphid-borne soybean mosaic virus (Ruesink and Irwin) require far more detailed inputs such as data on aphid trap catches and levels of seed transmission of virus, but they also provide far more detailed predictions of virus incidence and effects on yields. Better yet, they provide new insights to guide plant breeding efforts and to adapt different control strategies to local conditions. For example, their models indicate that reducing the rate of seed transmission of soybean mosaic virus relative to plant age at inoculation should greatly reduce virus spread where aphid vectors do not colonize soybean. This is a trait that breeders should have little trouble incorporating into commercial varieties.

Plant Virus Epidemics should itself serve as a model for future references and reviews of plant virus epidemiology. As such, it will be a reference for years to come. Its scope is comprehensive and varied, but the presentation is clear and coherent so that researchers from diverse fields such as plant pathology, entomology, agronomy, ecology, mathematics, and operations research should be able to understand the material outside their specialties and identify common ground on which they can integrate their efforts toward the new directions this volume suggests.

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Insect Chemoreception

Mechanisms in Insect Olfaction. T. L. PAYNE, M. C. BIRCH, and C. E. J. KENNEDY, Eds. Clarendon (Oxford University Press), New York, 1986. xviii, 364 pp., illus. $69. Based on a seminar, Oxford, U.K., Aug. 1984.

As the editors of this volume note, the use of olfactory signals as an alternative to pesticides in the control of insects has been slow to be implemented, in part because many fundamental questions, such as how insects recognize and locate odor sources, remain unanswered. This book summarizes our current understanding of some of the behavioral and physiological processes that underlie this emerging technology.

Its title notwithstanding, the book is not a general review of insect olfaction, although the 35 short contributed papers span an array of topics. An opening presentation by Dethier extolling the virtues of a comparative approach to understanding the chemical senses is particularly appropriate since research in insect chemoreception often parallels related studies on other species. The next 19 papers treat the behavior of insects locating odor sources. This area of investigation has a rich and controversial history. Although the question of how flying insects actually locate an odor source remains unanswered, it increasingly appears that the odor serves to trigger upwind flight and that directed locomotory movements are the result of internal steering guided by multimodal sensory input, including visual cues from surrounding vegetation. Among the important new findings are that spatial discontinuities inherent in odor fields, which flying insects apparently detect as temporal discontinuities, are critical for odor orientation, as are spatial and temporal perturbations of the odor field induced by the microhabitat in which the odors are released. Moreover, no single pattern of flight behavior, or therefore presumably of orientation strategy, necessarily characterizes all species of flying insects. Clearly, more remains to be learned, in spite of important and exciting progress.

The remaining 15 papers are physiological. Among the important new findings in this area is that pheromone receptor cells can follow odor pulses up to at least 10 hertz. Temporal sensitivity appears to be enhanced by inactivating enzymes that rid the receptor lymph of odorant molecules and that somehow coexist with other, soluble binding proteins, hypothesized to protect and carry pheromone molecules to dendritic receptors. Descending interneurons that "flip-flop" to different output states in response to changes in odor concentration offer further evidence of neural tuning to the spatiotemporal parameters of odor fields. The question of quality coding, how one odor is distinguished from another, remains elusive. It is increasingly clear that "silver bullet" chemical signals, single molecular species detected by dedicated neural circuitry in lock-and-key fashion, are not the general case. Multicomponent odors prevail, and interactions at the receptor cells, if not among other coactivated elements of the olfactory pathway, complicate the issue of quality coding. One consolation is that the neural substrate for quality coding continues to elude workers using other animal models. A particularly bright hope is the prospect of unraveling quality coding at higher levels of the insect olfactory pathway where one can begin to analyze the response spectra of interneurons with identifiable patterns of branching in olfactory neuropil.

This volume is not intended for general reading. Indeed, mastering the subtleties of orientation theory, not to mention the associated terminology, is no easy task. The editors give us a well-organized, timely overview that should provide advanced students of science easy access to the literature and to current ideas about how insects recognize and locate odor sources.

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Neutrino Mass

'86 Massive Neutrinos in Astrophysics and in Particle Physics. O. FACKLER and J. TRÂN THANH VÂN, Eds. Editions Frontières, Gif-sur-Yvette, France, 1986. xviii, 704 pp., illus. $69. Moriond Workshop 6 (Tignes, Savoie, France, Jan. 1986).

There is today no compelling evidence that neutrinos, the weakly interacting particles emitted in nuclear beta decay, have a nonzero mass. The implications of neutrino mass for particle physics and astrophysics are sufficiently intriguing, however, that large numbers of experimentalists and theoreticians study this subject. In fact it is believed that there are three different varieties of neutrinos, ν_e, ν_μ, and ν_τ, associated with the three charged leptons, the electron, the muon, and the τ particle. As a result there are three possible values of neutrino mass, and the neutrinos emitted in weak decays, like the ν_e, may be mixtures of mass eigenstates.

Measurements of the electron spectrum from the beta decay of tritium provide the best method for finding a small mass of the electron neutrino ν_e. The latest of a series of experiments in Moscow is reported here by Valentine Lubimov; since 1980 these experiments have indicated a nonzero mass of about 30 electron volts. The present volume provides the first reports of new experiments on the tritium spectrum by groups at SIN (near Zurich), Tokyo, and Los Alamos. None of these find a nonzero value, and the Zurich group reports an upper limit of 18 eV.

Even if experiments indicate that ν_e does