

Insects of Hawaii¹

(A REVIEW)

By R. H. VAN ZWALUWENBURG

This excellent work is the result of over fourteen years of scholarly effort by an author well qualified to bring together and to interpret the great mass of information on the insects of these Islands which has accumulated since the publication of "Fauna Hawaiiensis" nearly half a century ago. "Insects of Hawaii" is the result of cooperation by three scientific agencies in the Territory: the Bernice P. Bishop Museum, the Experiment Station, Hawaiian Sugar Planters Association, and the University of Hawaii, all of which contributed financially or otherwise to its production. It is the third publication to appear under the auspices of the recently created University of Hawaii Press.

For some fifty years "Fauna Hawaiiensis" has been the source-book of Hawaiian entomology. Useful though the "Fauna" will always be, so much new information has been gathered, and so many new insects, both native and immigrant, have been found here since its publication, that it is no longer adequate for the student whose first problem often is to know just what species he has in hand. So these volumes fill a real need, and indeed, are indispensable. They not only offer workable keys for identifying the local fauna, but in addition are a storehouse of information concerning the biology of the Hawaiian insects, their origins, importance to agriculture and health, their natural enemies, and, in the case of economic species, their control. The assembling of so much widely scattered, and often inaccessible data between the covers of a few volumes is a concrete contribution to Pacific biological science.

The five volumes consist of some 1700 pages; they contain some 3000 illustrations and about 275 keys for insect identification. The taxonomic pages treat in progressive order from the primitive to the more highly developed orders, the groups from the Thysanura through the mealybugs and scale insects. Later volumes, for which the groundwork has already been done, will discuss in similar manner the rest of the insect orders: the minor orders not previously considered, and the Lepidoptera, Coleoptera, Hymenoptera and Diptera.

In the chapter on the geological history of Hawaii in his "Introduction," the author discusses in clear, yet detailed fashion, the formation of the islands, their degradation (by marine action and erosion), their partial submergence and re-emergence, the age of the island chain and the comparative ages of the individual islands. In the chapter on "Dispersal" are discussed the means whereby plants and animals are spread about the world. The greatest hazard en-

¹ By Elwood C. Zimmerman. Vol. 1, Introduction, xx+206 pp. \$3.50; Vol. 2, Apterygota to Thysanoptera inclusive, viii+475 pp. \$5.50; Vol. 3, Heteroptera, i+255 pp. \$4.50; Vol. 4, Homoptera: Auchenorrhyncha, vii+268 pp. \$4.50; Vol. 5, Homoptera: Sternorrhyncha, vii+464 pp. \$6.00. University of Hawaii Press, 1948. Honolulu.

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countered by an immigrant species, it is pointed out, is its successful establishment in a foreign and often hostile environment; the percentage of failures is extremely high. Analysis of the native Hawaiian fauna leads the author to conclude that "... only about 250 overseas stragglers succeeded in becoming established . . . perhaps one successful colonization per 20,000 years!" From these few successful immigrants has the native Hawaiian insect fauna developed. Parenthetically, it is interesting to compare the meager success of insect immigration unaided by man, with the situation today. In spite of quarantines, not less than 45 immigrant insect species have arrived in Hawaii and established themselves here within the past four years.

In the chapter on "Analyses and Summaries of the Hawaiian Biota," Mr. Zimmerman points out that the number of indigenous insects is small in comparison with the endemic species; the latter approximate 99 per cent of the native species. Nearly two-thirds of the major insect groups known in the world are entirely absent from the native Hawaiian fauna, and these absentees are mainly among the geologically ancient orders. "There is no evidence whatsoever to indicate that there was any Hawaiian continental land mass or that these islands were ever connected by dry land to any continent. The very character of the fauna expresses the essence of oceanic isolation." The affinities of the native insects are over 90 per cent Pacific, and it is "noteworthy that most of the American elements are large, strong-flying insects." This chapter includes a summary of the Hawaiian land shells, and an essay by Dr. F. R. Fosberg on the "Derivation of the Flora of the Hawaiian Islands." The island plants parallel the insects in their origins, development and distribution.

The chapter on "Development of the Endemic Fauna" discusses the complex effects on speciation of repeated invasion and re-invasion of the individual islands, which will especially appeal to the student of evolution. Isolation of small populations on separate islands has resulted in the development of more species than would probably have resulted had the islands been joined in a single land mass. Not only well-reasoned and lucid, but at the same time highly readable, is the author's presentation of such topics as flightlessness, independent origins and developments, predacity and parasitism in the aboriginal fauna, centers of development and rate of evolution, and extinction of species in modern times. Mr. Zimmerman's "Introduction" is one of the most comprehensive and searching treatments of the problems of evolution under island conditions ever presented.

The taxonomic volumes contain a wealth of identification keys. They are profusely illustrated with at least one representative figure of each genus, and include numerous drawings by such superb entomological artists as Dr. Ferris, Mrs. Abernathy and Arthur Smith. The illustrations set a high standard of excellence, and leave little to be desired. Every student of Hawaiian entomology will want to have these indispensable volumes in his working library.