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# Zoogeography of Selected Aquatic Insects in New Caledonia

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The study of continental drift and plate tectonics is important to both geologists and biologists. Geologists are interested in understanding the evolution and ever-changing nature of continents, while biologists, especially historical biogeographers, are interested in possible paths of dispersal of ancient plants and animals. Both geological and biological data are important in understanding the historical evolution of all continental areas.

For many years I and others have been interested in the possible paths of dispersal of an ancient group of aquatic insects called Ephemeroptera, or mayflies, in the Southern Hemisphere. Our interest turned to New Caledonia in 1965 when Prof. Dr. F. Starmühlner of the I. Zoologischen Institutes der Universität Wien sent to us a collection of New Caledonian mayflies. The collection contained representatives of only one family of mayflies, Leptophlebiidae, and all the genera and species were unknown to science. Study of these mayflies indicated that they were related to other genera occurring in New Zealand, Australia, and South America, but not closely related to those of mainland Asia or New Guinea. As mayflies are sharply limited in dispersal, especially over vast areas of ocean (Edmunds, 1972), the question arose as to how these insects, and possibly other aquatic insects, could have invaded the island of New Caledonia.

Recent geological studies by Griffiths and Varne (1972) and Griffiths (1974) reconstructed the continental fragments of Gondwanaland in the southwestern Pacific. Prior to sea-floor spreading between the Campbell Plateau and Antarctica about 80 million years ago, Australia, Antarctica, Chatham Rise, Campbell Plateau, Lord Howe Rise, and Norfolk Ridge were all close together as one continental element. With the opening of the Tasman Sea about 80 million years ago and the start of the Alpine Fault about 50 million years ago, various continental fragments became isolated and drifted fur-

ther apart as time progressed. Based on these data, therefore, the island of New Caledonia is continental in origin.

If this geological hypothesis is correct then ancient ancestors of some plants and animals could have dispersed over land or across small areas of sea to the area that is now New Caledonia. Study of these ancient dispersals, often called palaeantarctic dispersal routes in the Southern Hemisphere, is based on the present geographical distribution and phylogeny of plants and animals. In many groups of plants and animals the present distributions can be explained only by various palaeantarctic dispersal routes. These routes are well illustrated by Edmunds (1972) for animals and by Raven and Axelrod (1974) for plants.

Most important animal data on palaeantarctic routes have been obtained from invertebrates, especially insects. Among the aquatic insects, excellent data have been reported by Brundin (1966) for Chironomidae, Illies (1969) for Plecoptera, Ross (personal communication) for Trichoptera, and Peters and Edmunds (1964, 1970) and Edmunds (1972, 1975) for Ephemeroptera.

In 1972, the Society made a grant available to me to collect and rear aquatic insects in New Caledonia for zoogeographical studies. The expedition included Dr. and Mrs. William L. Peters, their daughter Rae Ellen, Dr. and Mrs. George F. Edmunds, Jr., and Prof. William M. Beck, Jr. These members collected aquatic insects throughout New Caledonia from September 6 through November 15, 1972.

## *Results*

During the expedition to New Caledonia large numbers of aquatic insects were collected in both the immature and adult stages. Many were reared from immatures to adults, especially Ephemeroptera and Chironomidae. After curation all insects were sent to various specialists throughout the world for study. In most cases taxonomic and phylogenetic studies had to be completed before zoogeographical studies could begin. At the writing of this report (1977) many studies are only partially completed, and it will be many years before all studies are completed. Listed below is progress made to date on some of the groups of aquatic insects.

1. Ephemeroptera—studied by W. L. and J. G. Peters, Florida A&M University, and G. F. Edmunds, Jr., University of Utah. Except for two adult specimens of *Pseudocloeon*?, all mayflies collected in New Caledonia were Leptophlebiidae. All genera and species are new to science and all are endemic

to New Caledonia. A series of taxonomic manuscripts has been prepared and will be published in the publications of the Office de la Recherche Scientifique et Technique Outre-Mer (ORSTOM) in Paris.

Phylogenetic studies indicate that these Leptophlebiidae in New Caledonia are most closely related to modern representatives in New Zealand. Evolution of the main Southern Hemisphere phyletic lines appears to have occurred while New Caledonia and New Zealand were connected or in close proximity to each other. Most of these phyletic lines also have more distantly related modern representatives in Australia, southern South America, Africa, Madagascar, Sri Lanka, and southern India. Results of the phylogenetic and zoogeographical studies will be published in ORSTOM publications.

2. Odonata—studied by M. A. Lieftinck, Rhenen, the Netherlands. All results based on our collections and collections of others have been published by Lieftinck (1975, 1976).

3. Trichoptera—studied by H. H. Ross, University of Georgia. At present, studies on the New Caledonian caddisflies are continuing. Ross (1974, 1975) has published results on the Helicopsychidae.

4. Plecoptera—no stoneflies were collected by the expedition in New Caledonia, and this order appears to be absent from the island.

5. Chironomidae—studied by W. M. Beck, Jr., Florida A&M University. At present, studies on the New Caledonian midges are continuing.

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