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 HOOKWORM AND FILARIASIS IN AUSTRALIA.

own destruction, and of the nature of empty tins, bad gutters, &c.; the use of mosquito nets, particularly by infected persons; moving infected persons if possible as far south as Sydney, where the disease will gradually die out without the danger of infecting others.

This Department is continuing investigation in the northern areas, and the following points have been considered worthy of consideration:—

1. Is surgical filariasis increasing?
2. What is the domestic mosquito population where filariasis is prevalent?
3. What possible vectors exist?
4. Experimental investigation of these vectors.
5. What is the method by which the larvae enter the skin?

 Australian Fish as Mosquito Larvae Destroyers.

By the late L. E. COOLING, Entomologist, Australian Institute of Tropical Medicine, Townsville.

[Foreword.—At the time of his death in December, 1924, Mr. Cooling was engaged in a continuance of his study of larvivorous fishes, some account of which, amongst other writings, he had published in *Health** for April, 1923, and in the Service Publication on "Malaria"† by Dr. R. W. Cilento. The following article has been extracted from his notes.]

WE find few references in the scientific literature of Australia calling attention to our larvivorous fish.

Froggat, in 1905, wrote: "If ornamental garden ponds and creeks are stocked with small fish . . . they will soon devour all the mosquito larvae and pupae as they come along and keep it clear of these pests before they have time to mature."

A slightly fuller reference was made by David G. Stead in 1907:—"In the first case there is not the slightest doubt that most small pond fishes are an important factor in controlling to some extent the supply of mosquitoes, as well as of other insects which possess aquatic larvae, as they prey upon them greedily whenever opportunity offers.

"Amongst our own indigenous fishes, no more inveterate enemies are to be found than the various species of Minnows (*Galaxias*) which are plentifully distributed throughout the eastern division of New South Wales. These are all highly active, agile, surface-swimming fishes, always on the go and always ready for food; and they are to be found in great profusion in every creek and in almost every natural pond, even though the latter be of very small size. In addition, they are to be seen in very many permanent artificial ponds, such as are found in brick yards.

* "Mosquito-Larvivorous Fishes in Relation to Mosquito Reduction Work in Australia," *Health*, April, 1923, page 94.

† *Malaria, with Especial Reference to Australia and its Dependencies*, Service Publication (Tropical Division) No. 3, page 76.

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"In ponds where the Minnows do not occur their place is usurped by that ubiquitous introduced pest, the common Gold Fish or Silver Fish (*Carassius auratus*), which, if not as active as the Minnow, is just as hungry for mosquito larvae."

A third reference is by Bancroft in 1908: ". . . a few small fish, e.g., Eleotris, Gobies, or even Gold Carp, introduced into them (mosquito breeding ponds) would devour the larvae."

Australian Gobies, however, are not representative mosquito destroyers if we exclude the useful "Firetailed Gudgeon," so called (*Carassiops (Austrogobio) galii*).

At the instigation of Ruge, the German Government in New Guinea, after two failures, transported and acclimatized Australian larvivorous fishes in the Bismarck Archipelago (Bornstein, 1914). The fact that *Melanotaenia nigrans* has been recorded on several occasions from New Guinea was probably unknown to the Germans. It was, indeed, a case of bringing coal to Newcastle.

However, in the third and successful attempt, four species of fish, *Galaxias attenuatus*, *Polyacanthus opercularis* (*Macropodus viridiviratus*, the Paradise Fish), *Carassiops (Austrogobio) galii*, and *Pseudomugil signifer* (Blue Eye) were imported from Sydney. The fishes were placed in glass vessels, and in spite of the addition of fresh water and a plant, *Vallisneria spiralis*, the mortality was considerable; 50 per cent. of the Paradise Fish died, but all of the *Galaxias* lived.

On arrival at Rabaul the fishes were placed in a cement tank, where it was proposed to breed them and distribute them throughout the Bismarck Archipelago.

The ideal mosquito larvivorous fish is one that is small, preferably not above 50 mm. in length; it must be capable of adjusting itself to various environments, such as stagnant and running water, water in artificial containers, as well as in natural pools, swamps, and water-courses. It should naturally frequent the shallow waters inhabited by mosquito larvae, and be able to move freely in aquatic vegetation; it must be preferably a top feeder, and above all it must be naturally aggressive towards mosquitoes.

A carnivorous fish is better than an omnivorous one, at least under natural conditions, although in an aquarium it might apparently excel a more useful fish.

In general terms, for mosquito reduction work, small fish of the families of *Cyprinodontidae* or *Poeciliidae*, found in almost all parts of the world, are useful.

In Australia, however, these families are not represented, although we have equally good ones. The families that include the typical enemies of mosquito larvae are the *Atherinidae* (Silversides), of which the genera *Melanotaenia* and *Pseudomugil* are of use. The family *Centropomidae* (including the genus *Ambasis*) also contains good larvae destroyers. The family *Gobiidae* is perhaps less representative, containing as it does only one species worthy of mention, i.e., *Carassiops galii*.