13. Have confidence in and a real love for the work.

Many of the first nine points of Silvestri's advice have been modified by the advent of modern air transport, but the harsh realities of numbers 10, 11, and 12 are still with us. Therefore in these days of creature comforts with the forty-hour, five-day week being the rule rather than the exception it is perhaps surprising that anyone now undertakes the task of foreign collecting. However, there are persons who do this work today, and it is to them that economic entomology owes a real debt. This article is submitted as a minor tribute to these men and to acknowledge the personal sacrifice that they must make to carry on their work for the ultimate benefit of American agriculture.

Hardships of a Parasite Hunter

The difficulties encountered in foreign exploration and the characteristic perseverance of the men who do this work are well illustrated in the work of Dr. Frederick Muir, who searched for natural enemies of a sugar cane borer that was very damaging to the plantations in Hawaii at the turn of the century. Dr. Muir's published articles tell a few of the extraordinary hardships that a man encounters when he gives himself over to an enthusiastic study of science. Muir had traveled in search of the parasites of the cane borer, Rhadoecetes obscura (Boisd.), through much of the East Indies and into the interior of Borneo without having much success. Therefore he moved his operations to Ambon, where after working in the miserable Sago swamps from April to August he managed to get sufficient material to go on to Ambon, but in spite of all the care he could give the insects they all died the day before he arrived with them in Hong Kong. Muir returned to the Moluccas to work out some more suitable way of handling the parasitic parasites so that they could be transported successfully. He returned to Ambon in November, 1909, but had to wait a month for the mail boat to Ceram. He reached Ceram in the wet season and reported that "Never one day did I come home dry, on most days returning soaked from head to foot, and often spending hours in water up to my knees." With conditions so bad he decided to go to New Guinea.

"Upon arriving at Port Moresby the doctor told me I could land, but would have to go into quarantine, so I decided to do so. This proved quite a little Gilbertian episode which lasted five days. The quarantine house is a one-roomed iron place on the west side of the hill at the entrance of the harbor. I moved in with my boxes, a few cooking pans, and some tinned meats and biscuits, to live in splendid isolation for five days."

After leaving quarantine Muir moved to a camp in the Laloki district 15 miles from Port Moresby. To get there he had to cross the crocodile-infested Laloki river on fallen trees. Such bridges were inconvenient to cross and "I sometimes preferred to cross on the seat of my trousers rather than on soles of my boots." Muir found a small parasitic fly at Laloki and he thought it best to remain there to collect it. His abode was a temporary one-roomed grass affair next to a swamp. The mosquitoes were terrible and at sunset he lighted a wood fire in the center of the room and turned it into bed early.

Muir realized that "The difficulty is to get these small flies from such a distance, the shipping facilities being very poor, and great delay in trans-shipment being unavoidable. The best route is from Papua to Brisbane, and then by Vancouver boat to Honolulu, but the difficulty is to avoid delay along the Queensland coast."

"The method I decided upon was as follows: First, to get large colonies of borers established in healthy cane stems in the fields, then to expose them to the attacks of parasites under natural conditions, and then transfer root and stems to my cages and bring them back. By having a stock of unparasitized borers on hand I hoped to be able to get a second generation en route should the first hatch out before I reached Honolulu."

Muir prepared the material as planned but bad luck overtook him and before leaving Port Moresby he contracted typhoid fever, which compelled him to call in a doctor when he reached Brisbane. The doctor sent Muir to the hospital where he remained five weeks. A friend kindly put Muir's boxes on board the ship to Honolulu but with no one to attend to them during the voyage none arrived alive, although hundreds of the parasites had hatched out and died en route. So Muir returned to New Guinea to try once more.

With the education which came from these bitter experiences Muir decided to set up a breeding station at Mossman, Queensland and a Mr. Kershaw established this station while Muir was making his second collection of parasites in New Guinea. Finally arrangements were all completed and Muir managed to put a shipment together in April. He took it to Port Moresby on April 21, but the boat which was scheduled to leave on April 22 was six days late. In the meantime Muir became ill with fever and went to the hospital where his room was a part of a balcony divided off with corrugated iron with only two feet between his bed and the iron wall. Weak as he was Muir went from the hospital aboard the ship which took him to Cooktown, Queensland. He missed the mail connection and thus had to wait in Cooktown 5 days although it was only 60 miles down the coast to his planned meeting with his helper, Kershaw. To add to his frustrations, the post office took 24 hours to get a telegram to Kershaw over this 60 miles. Finally, Muir got to Mossman on May 5 with 8 adult parasites still alive, and some puparia from which 83 adults later emerged. These were all put into the breeding cages which had been suitably prepared by Kershaw.

The following four weeks were a time of great suspense, because they were not sure that the flies would successfully breed. But they did rear through a generation of the parasites, and on June 29, Muir left Australia for Fiji taking 155 puparia with him. He planned to remain a month in Fiji to breed more flies, and he barely had time to stock a cage with the parasites when he again succumbed to malaria and went to the hospital in Fiji for two weeks.

Finally, on August 9, 1910 Muir left Fiji with his new generation of parasites and arrived in Honolulu on August 16 with a good colony of adult flies and puparia. The subsequent establishment of the New Guinean parasites in Hawaii soon lessened the borer damage so that on most of the plantations the injury is no longer serious. As a result of the suppression of the borer there was an increase of about 0.7 tons of sugar per acre, and therefore the years of effort by Dr. Muir to introduce the parasite were amply justified.

It is necessary that a parasite collector be a keen observer of factors which cause mortality in his field. Through such observations natural enemies are discovered which were previously not known to exist. Dr. Muir's discovery of the feeding habits of the now famous predaceous bug, Cyrtorhinus mundulus (Bredl.), is a case in point. This insect was known in Australia and Java, but because it belonged to a family of insects that characteristically feed on plants it was almost ignored as a feeding insect. In 1910 Muir was in Australia searching for parasites of the sugar cane leafhopper, Perkinsella saccharicida Kilk., which was a very destructive pest in Hawaii. Muir noticed in Australia that a large percentage of the eggs of the leafhopper were dead and attacked by a fungus. In his account of this Muir wrote, "I found the fungus in the form of yeast-like spores present in old egg shells from which the young had hatched, which could be recognized by the egg case being off, and also in unhatched eggs, which in itself was intriguing. In moist cells these spores gave rise to mycelia and then to fruiting bodies and yeast-like spores
There have been many other parasite collectors beside Dr. Muir, and their travels and experiences are every bit as fascinating. George Compere began ten years of this work in 1890 and his travels in search of parasites of the fruit flies were so remarkable and extensive that a French entomologist, Paul Marchal, wrote of them as "L'incomparable Odyssée de Monsieur Compere." There is now a second generation of parasite collectors. Harold Compere has made a permanent place for himself in entomology's hall of fame by doing the same type of work as did his father, George. The parasites which controlled the citrusphloin mealybug in California and also the parasites which are most important in suppressing the black scale in the same state were discovered by Harold Compere in Australia and Africa, respectively.

The explorer's work may still not be finished even though he has collected the material, packaged the insects very carefully, and has taken them to the post office for shipment. A collector recently learned that his shipments were not arriving at their destination and found that the postal clerks were removing the valuable, unenclosed airmail stamps and reselling them. They were tempted to do this because the amount of postage on the package was equivalent to about a month's wages for the postal clerk in that backward country.

The First Parasite Hunt

No account of parasite collectors would be complete without mentioning the first person who set about to obtain parasites in the native home of a pest. This man was Albert Koebele, an employee of the United States Department of Agriculture. In 1883 Koebele was working in Washington, D. C., and after what is said to have been an unfortunate love affair he asked to be transferred to some distant place. The most distant place then was California and so Koebele was sent there to work on insect problems, the most important of which was the control of the cottony cushion scale on Citrus. In 1888 it was decided that someone should be sent to look for parasites of this scale insect in Australia. There was a ban on travel outside of the United States by members of the Department of Agriculture, but this was circumvented in a very interesting way. There was a world's fair in Melbourne that year in which the United States was to have an exhibit, and a congressman from California was in charge. To aid his fruit growers in their effort to obtain parasites of their scale pests he arranged to have Koebele accompany his commission to the fair, ostensibly to represent the State Department but actually to collect insect parasites. Koebele succeeded in finding the now famous Vedalia beetle which not only controlled the scale in California but did it in such a dramatic and spectacularly successful way that biological control was firmly established as an important method of suppressing pests.

Koebele was skyrocketed to fame as a result of his Australian trip. The Germans with some nationalistic pride called biological control the Koebele method, since Koebele was born in Germany. The California fruit growers gave Koebele a testimonial banquet and presented him with a gold watch and Mrs. Koebele with a pair of diamond earrings. This event prompted Koebele's biographer to write, "I imagine that this presentation of diamond earrings to the wife of an entomologist as the result of his own work in entomology is probably unique. I happen to know of no other entomologist who has been able to see that his wife wears diamond earrings."

Biological control is now 72 years old, and the Vedalia has maintained its complete control of the cottony cushion scale in California for all of this period. This demonstrates the permanence of the method when an effective parasite becomes established. The hunt for parasites continues today and the search has been broadened to include enemies of weeds. The introduction of weed-feeding insects has resulted in impressive control of certain weed species in California, Hawaii and Australia. The value of biological control is thus very evident and it has gained world wide recognition and support, but the surface has barely been scratched and the parasite hunters will be needed for many more years.

Cryptolaemus montrouzieri, a lady beetle which feeds upon mealybugs. This beneficial beetle was imported from Australia by Albert Koebele in 1892

Photos John Black