The Sting of Defeat: A Brief History of Insects in Warfare

The rove beetle *Paederus fuscipes* (left), when crushed, emits a chemical that causes dermatitis and blistering on human skin, and it is an early example of an insect used in human warfare. The "Skeeter" unmanned aerial vehicle prototype (right), meanwhile, is a modern example of insect-inspired military technology. (Photo credits: (left) Merle Shepard, Gerald R.Carner, and P.A.C Ooi, Insects and their Natural Enemies Associated with Vegetables and Soybean in Southeast Asia, Bugwood.org; (right) Animal Dynamics)

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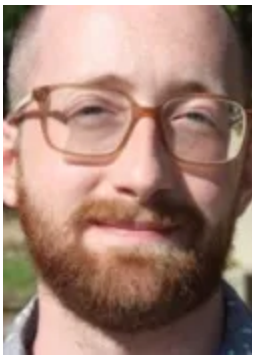

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Humans have waged entomological warfare, the use of insects and other arthropods as part of wartime tactics, in myriad ways for thousands of years. The long history of entomological warfare makes it a fascinating subject with many interesting examples from both entomological and sociological standpoints. This brief review is not meant to make light of this serious subject but rather to encourage reflection on sometimes regrettable actions of the past and inspire hope for positive humanitarian applications of entomology in the present and the future.

Entomological warfare (EW) has manifested through human history in three main forms: insects directly used as weapons, insects used to destroy crops, and insects used as vectors to inflict disease. More recently, though, insects have become sources of innovation for advanced military technology.

Insects as Weapons

During the Second Parthian War, King Barsamia used scorpion-stuffed pots thrown at the enemy to defend the ancient Middle Eastern city of Hatra from the Romans. It's possible that these literal bug bombs also contained rove beetles in the genus *Paederus*. These small rove beetles' hemolymph contains the compound pederin. Pederin causes dermatitis and blistering when contacting skin, a likely scenario when panicked warriors began smashing beetles thrown onto them. King Mithridates VI of Pontus also enlisted arthropods in his wartime maneuvers but favored those of the hymenopteran persuasion. During the Third Mithridatic War, Mithridates ordered grayanotoxin-laden honey created by rhododendron-foraging honey bees to be left along roads for pursuing Roman invaders. Warriors eating this honey as part of their pillaged loot experienced intense sickness and hallucinations, giving it the name "mad honey." The incapacitated Romans were then easy targets for Mithridates' army. Mithridates also ordered the release of hornets and bees into sapper tunnels dug beneath battlefields. Clearly, applied entomology has a very long, if brutal, history.

Insects as Crop Pests

Deploying insects to destroy enemy crops is an odious act of EW of which many countries have accused one another, but it also one that is rarely proven. In 1944 Germany was accused of slipping Colorado potato beetles into Britain to decimate crops. After the Vietnam War, North Korea accused the United States of releasing insects in its agriculture (though any plant loss may have actually been caused by the defoliant Agent Orange). And in 1997 Cuba accused the U.S. of aerially dropping thrips onto the island during the Cold War. It's near impossible to prove if these claims are true, but they certainly served their purpose of elevating one country's complaints against another onto the world stage. Modern EW like the use of insects to destroy crops would be banned under the Biological Weapons Convention of the Geneva Conventions. Of course an individual country can ignore these conventions at any time, and not all countries subscribe to them in the first place.

Insects as Disease Vectors

Mosquitoes and yellow fever, lice and typhus, fleas and plague: Such insects may be most infamous as vectors of debilitating diseases. From Napoleon's conquests to the American Civil War, battles and wars have been decided by these insect-initiated illnesses, whether accidentally or intentionally (such as the catapulting of plague-ridden corpses over city walls). Many countries have investigated the efficacy of insects and their associated diseases as biological weapons, including the United States, which has tested insect-based tactics on American citizens, notably in Operations Drop Kick, Big Buzz, and Big Itch. But the case of Dr. Shiro Ishii is perhaps the most disturbing example of vectors being used for entomological evil.

Dr. Shiro Ishii was a microbiologist and a Japanese army medical officer during the Second Sino-Japanese War and World War II. As he rose through the ranks, Ishii was placed in charge of building

and running Unit 731, a top-secret biological weapons research and development facility. Unit 731 was established in northeast China in a Japanese puppet state on nearly 6 square kilometers of land. Officially, Unit 731 operated as a water purification plant and lumber mill, part of the Epidemic Prevention and Water Purification Department of the Kwantung Army. Ishii and others working at Unit 731 would eventually kill well over 10,000 Chinese citizens and prisoners of war over the years. They referred to their victims as *maruta* or "logs," which both referenced the cover story of being a sawmill and revealed their complete disregard for the lives of these people. Unit 731 investigated, among many deplorable things, the best disease and vector combinations to attack an enemy and the best way to introduce that vector, via water supply, air, on so on. For an in-depth account of the work of Ishii, and more on EW in general, the book *Six-Legged Soldiers: Using Insects as Weapons of War* by Jeffrey Lockwood is a highly recommended read.

Insects as Inspiration

More recently, our ever-adaptable insects have a new role in warfare, one of bioinspiration rather than weaponry. An alloy capable of returning to its original shape, based on the cuticle of the ironclad beetle, is being developed for use in military vehicles. An engineering firm in the United Kingdom is developing a defense surveillance drone called the Skeeter with flight capabilities based on those of dragonflies. And many people have heard of the RoboBee, a tiny flying robot with mechanics based on insects that could also have covert surveillance applications. With these as just a few of the ways insects continue to inspire innovation, entomology clearly has a bright future. As all entomologists know, there is still so much to learn from and about insects.

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