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EDITORIAL

History and Entomology: Insects and War

History and entomology have little in common; subjects that appear to a disinterested observer as different as chalk and cheese. Children are exposed to both, a little history and a little zoology at school. A vast majority of students heave a sigh of relief when they leave these subjects behind them, their memories no longer taxed by the need to remember a great deal of factual information, which appears to have little bearing on their future careers. History is sometimes taught as a succession of battles and wars that have often been decisive in shaping the world as we know it. Entomology, the study of insects, is an esoteric activity. For most people insects seem an unglamorous subject of study. Having shed history at school and having no recollection of any classes that dealt with insects, I was drawn irresistibly to an article that appeared in the latest edition of the *Annual Review of Entomology*. The volume contains scholarly reviews of the current status of subjects as diverse as 'Insect nuclear receptors', '*Plasmodium knowlesi*: A malaria parasite of monkeys and humans' and 'Evolutionary ecology of Odonata'. A glance at a formidably technical table of contents should have been sufficient to dissuade me from further exploration of the book. However, the title of one review captured my attention. 'Insects as weapons of war, terror and torture' (Lockwood, J. A., *Annu. Rev. Entomol.*, 2012, **57**, 205) is a gripping account which weaves together history and entomology, chronicling major human conflicts where insects became weapons in the hands of man.

The diversity of living organisms has always fascinated observers of the natural world. More than a century before Darwin, Carl Linnaeus began to describe and classify the observable world around him, laying the foundations of taxonomy. In his initial classification three major kingdoms emerged, Animal, Vegetable and Mineral. Of these, the last would disappear from the living world of biology, to be consigned to geology and chemistry, subjects that dealt primarily with inanimate matter. The animal kingdom, so evident around us even in the midst of the most crowded urban environments, is dominated by an abundance of insects. Cockroaches and spiders, flies and mosquitoes, ants and grasshoppers, bees and wasps are easy to find. A casual survey of any mildly open area will reveal a host of insects, many of which are invariably viewed as pests. For farmers, waging war on insects that

attack crops, is an occupational chore. Insecticides, chemicals toxic to both insects and, at times, man, are invariably pressed into service. Some estimates suggest that insects make up about 90% of the animal kingdom. Entomology may indeed be one of the most important areas of biology. Honey and silk are produced by insects, examples where insect biochemistry has been harnessed to serve human needs. Amongst insects, beetles of the most varied appearances can be readily seen. J. B. S. Haldane in his 1949 book, *What is Life, The Layman's View of Nature* wrote: 'The Creator would appear endowed with a passion for stars, on the one hand and for beetles on the other, for the simple reason that 300,000 species of beetles are known, and perhaps more, as compared with somewhat less than 9000 species of birds and a little over 10,000 species of mammals. Beetles are actually more numerous than the species of any other insect order. That kind of thing is characteristic of nature.' Haldane, of course, is credited with the more memorable turn of phrase, where he is reported to have said that the Creator, if he exists, 'has an inordinate fondness for beetles'. An oft told story, probably apocryphal, suggests that this was Haldane's response in a conversation with theologians who asked, 'what can one conclude as to the nature of the Creator from a study of his creations?' The phrase 'inordinate fondness for beetles' appears to have acquired near immortality, despite doubts about its origins. As always, the internet provides a marvelous resource for those who like to check the origins of their favourite quotes – *Quote Investigator* (dedicated to the investigation and tracing of quotations, <http://quote-investigator.com>).

Insects are small and light; their size conferring on them characteristics that are absent in large animals. In his classic essay 'On being the right size', Haldane explains why 'an insect ... is not afraid of gravity'. Insects always seem to be defying falls and gravity with a disdain that can hardly be emulated by larger animals and certainly not by man. Haldane notes: 'You can drop a mouse down a thousand-yard mine shaft; and, on arriving at the bottom it gets a slight shock and walks away. A rat is killed, a man is broken... For the resistance presented to movement by the air is proportional to the surface of the moving object. Divide an animal's length, breadth and height each by ten; its weight is reduced to a

thousandth but its surface only to a hundredth. So the resistance to falling in the case of the small animal is relatively ten times greater than the driving force.' In his essay 'Size and shape', Stephen Gould was, as always, eloquent: 'We are prisoners of the perceptions of our size and rarely recognize how different the world must appear to small animals. Since our relative surface area is so small at our larger size, we are ruled by gravitational forces acting upon our weight. But gravity is negligible to very small animals with high surface to volume ratios; they live in a world dominated by surface forces and judge the pleasures and dangers of their surroundings in ways foreign to our experience' (McGarr, P. and Rose, S. (eds), *The Richness of Life: The Essential Stephen Jay Gould*, Vintage Books, London, 2006, p. 320). Even idle, untrained watchers of insect colonies always come away with a feeling of wonder for the diversity of biology.

Having rarely thought about insects, except when confronted with pests at home, I found a current review on the use of insects as weapons of war quite intriguing. Lockwood's article in the *Annual Review of Entomology* traces the uses of insects in war from pre-historic times to the present day. He notes that 'for thousands of years insects have been incorporated into human conflict with the goals of inflicting pain, destroying food and transmitting pathogens'. Clearly, insects can be 'weaponized' in many ways. The use of potent toxins extracted from insects to coat spears and arrows dates back to times before recorded history. Lockwood draws attention to Biblical accounts and Mayan texts which detail the use of insects. Tossing beehives at enemies appears to have been an early but possibly hazardous tactic. He describes a Greek account of a poison from India, now known as pederin, 'a toxin secreted by *Paederus* beetles (Staphylinidae)'. Curiously, he cites a book published in 2003 (Mayor, A., Greek fire, poison arrows and scorpion bombs. *Biological and Chemical Warfare in the Ancient World*, Overlook, Duckworth, New York) to add that pederin 'continues to be of interest to the Indian Defense Ministry'. Insects often transmit disease, serving as vectors that shelter and transmit pathogenic microorganisms to animals and humans. While the mechanisms by which contagious diseases spread have become well understood only in recent times, plague was transmitted by fleas in a victim's clothing transported into enemy lines. Lockwood notes that 'fleas can survive for hundreds of days between blood meals, so they could have functioned as an entomological booby trap'.

Military strategy in ancient wars was sometimes based on an intuitive understanding of the connections between

insects and disease. Even in the fifth century BC, in an era long before 'explicit entomological knowledge' became available, an 'Athenian army was decimated by malaria when Sicilian commanders maneuvered their defensive lines to force the invaders to establish summer camps in the marshes or perhaps drew the enemy into the wetlands through the ruse of negotiating surrender'. Lockwood's sweep through history moves from the Middle Ages to the Napoleonic Wars. 'The tactic of launching biological materials into a besieged city is rooted in the fourteenth century.' Lockwood summarises scholarly studies that suggest that the plague which decimated Europe in the first half of the 14th century, killing 'more than one quarter of the continent's population' may have its origins in the Mongol siege of 'the Genoese seaport of Kaffa on the Crimean peninsula'. The spread of disease may have been hastened by the Mongol act of catapulting infected 'corpses into the city'.

Napoleon has never ceased to attract military historians. The influence of insects and disease on the Napoleonic campaigns is the subject of a fascinating account by R. K. D. Peterson (*American Entomologist*, 1995, **41**, 147). War and disease are intimately linked; 'deadly comrades' in Peterson's words. In Napoleon's time the connection between microbes, their insect hosts and disease was unknown. The insights of Pasteur, Koch and Ross were to come many decades later. Napoleon's campaigns were derailed by 'bubonic plague in Jaffa, yellow fever in Haiti and typhus in Russia'. Typhus in the trenches was probably more decisive in determining military outcomes in World War I than battlefield heroics, leading to the comment that many famed battles 'are only the terminal operations engaged in by those remnants of the armies which have survived the camp epidemics' (Zinsser, H., *Rats, Lice and History*, Transaction Publ., Edison NJ cited by Lockwood, 2007). The modern era where entomology meets war includes examples from World War II, the Korean conflict and Vietnam.

Insecticides, vaccines, antibiotics and a host of other pharmaceuticals now provide a defense against insect borne disease. But, there is an ever present danger of deliberate threats to agriculture which cannot be ignored. Lockwood raises the spectre of insects being potential weapons in 'asymmetrical conflicts'. In his words: '...the arc of history may suggest the future of entomological armaments'. Human history has been shaped by a myriad factors. It is a sobering thought that insects are among them.

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