Mosquito. Andrew Spielman and Michael d'Antonio. Faber & Faber, 3 Queen Square, London WCIN 3AU, UK. 2001. Paperback 7.99 pounds sterling. 247 pages.

To people living in malarial areas, the whine of a mosquito can be the music of death. Every 20 seconds someone somewhere dies of malaria, which is caused by a small protozoan parasite transmitted by the female mosquito, which can introduce 30 or 40 of the parasite into the human bloodstream at a single bite. Malaria is the third deadliest disease after dysentery and tuberculosis. Today, it is estimated that between 300 and 500 million cases of malaria occur every year, of which over a million people perish, most of them being children less than 5 years of age from Africa and Asia. Malaria is endemic in about 100 countries, affecting 40% of the world's population. As Andrew Spielman of Harvard University and Michael d'Antonio point out in their scholarly and authoritative book *Mosquito*, 'Mosquitoes have felled great leaders, decimated armies, and decided the fates of nations'.

Ancient Rome was the malarial capital of Europe. It was a commonly held belief among many people then living in Rome that malaria was caused by bad air (*mal aria* in Italian). Malaria remained a mystery, associated with 'emanations' from the earth. In Rome, it killed both peasants and popes alike. Even Alexander the Great was no match to the malarial mosquito, whose bite probably killed him in 323 BC.

In the first part of the book, the authors provide an insight into the world of the mosquito, which they refer to as the 'angel of death'. The second part of the book deals with diseases such as filariasis, malaria, yellow fever, and dengue and traces how the connection between them and the mosquito was established. In the final section, the book outlines the history of man's struggle to live with the mosquito, assesses the progress made to date in combating many of the mosquito-borne diseases, and draws our attention to the fact that despite all the advance in modern technology, the mosquito retains the capability to strike anyone virtually anywhere in the world today.

Only mosquitoes of the genus *Anopheles* are capable of transmitting malaria to man. There are some 60 species of them. The female mosquito bites man, as she needs a blood meal to fuel the production of eggs. Not all mosquitoes are bloodsuckers. Of the 2500 species of mosquito known to science, only a minority feeds on human blood. Mosquitoes differ in their idiosyncrasies and search for their blood meal at various times of the day. *Aedes aegypti*, which transmits dengue and yellow fever, prefers to bite people on their ankle or calf. This is why many secretaries in India are seen often jiggling their legs up and down almost continuously (a habit Spielman and d'Antonio refer to as the Babu Bounce) to ward off this mosquito! *Culex pipiens* the vector of West Nile virus comes out to feed after dark. Species of *Anopheles* are mainly active after dusk and just before dawn.

Patrick Manson, the Father of Tropical Medicine, had established the link between filariasis or elephantiasis and the mosquito (*Culex pipiens*) in 1875 when he was stationed in Taiwan. But he erred in presuming that the parasite was transmitted in the drinking water, the same mistake he made in regard to the mode of transmission of the malarial parasite later in 1894. It was the Italian Amico Bignami who correctly suggested that it was the mosquito that transmitted the parasite by way of its bite. But even Bignami was not the first person to observe that a blood-feeding creature could acquire and transmit a pathogen via its bite. The honour for the discovery must go to the American Theobold Smith who in 1893 demonstrated such a connection between a tick and cattle in the American west. Spielman and d'Antonio credit the French Army doctor Charles Laveran with the discovery of the malarial parasites in the blood of an infected person in 1880, for which he received the Nobel Prize. In 1886 Camillo Golgi having identified the human malarial parasites *Plasmodium vivax* and *P. malariae*, recognized *P. falciparum* as the most lethal parasite causing malaria in man. But it took a British doctor to demonstrate how the malarial parasite entered the human blood stream. He was Ronald Ross, born in 1857 in the foothills of the Himalayas and educated in England. He became a member of the Royal College of Surgeons at the age of 27 and was posted to Bangalore by the Indian Medical Service.

In 1894 on his return to England, Ross met Patrick Manson who encouraged him to explore the link between mosquito and malaria. On 20 August 1897, while working in Secunderabad (India), Ross made the critical observation that proved that malaria was indeed transmitted by mosquito, for which he received the Nobel Prize in 1902. Ross discovered some 'peculiar pigmented cells' or oocytes lodged in the stomach wall of an *Anopheles* (or 'dappled-winged') mosquito. The oocytes came from a blood meal that the mosquito had had from a patient called Hussein Khan who had agreed to be the guinea pig in the experiment for which he received an anna for every bite of the mosquito. The British Army in India was no match for the protozoan parasite; about 40% of the 178,000 soldiers were incapacitated with malarial fever in 1897 – the year Ross identified the *Anopheles* mosquito as the intermediary or vector in the transmission of the disease. About that time, in Panama, both malaria and yellow fever claimed the lives of two-thirds of the European workers engaged in the construction of the Panama Canal. Ross then moved to Calcutta in 1898 and established the cycle of avian malaria, but the credit for working out the complete life cycle of the human malarial parasite must go to the Italian team led by Giovanni Battista Grassi.

One hundred and five years after Ronald Ross conclusively established the link between mosquito and malaria, the complete genome sequences of the protozoan parasite *P. falciparum* appeared in *Nature* on 3 October 2002, while those of the mosquito vector, *A. gambiae* were published in *Science* the next day, 4 October. In the words of P. Balaram (Editor of this journal), this discovery of the genome sequences 'marks a milestone in the long struggle against malaria'. We now know not only that about 60% of the 5268 genes so far identified in *P. falciparum* are new to science, but also that genetically *Plasmodium* appears to be closer to plants than to animals! Elimination of malaria will depend on the eradication of the malarial parasite or the mosquito that transmits it. Scientists fall into two camps depending on whether they believe that the key is to eradicate the mosquito or treat the sick with antimalarial drugs. Only three out of the 1223 new drugs that were registered between 1975 and 1996 proved antimalarial. The struggle is in no way over.

As far back as 1900, one of the most aggressive and successful anti-malaria campaigns was carried out in the USA by the entomologist John B. Smith, who pioneered methods that were copied by many who followed him. Smith was more interested in controlling mosquitoes than in their extermination. He identified the breeding areas of mosquitoes and drained them, filled them with sand pulled from river bottoms, and even poured oil onto the waters where mosquito larvae bred. People and press ridiculed his efforts but the population of 'the New Jersey mosquito' *Ochlerotatus sollicitans* crashed. Similar tough measures adopted in Cuba by the US Army Major, William Crawford Gorgas eliminated yellow fever from Havana. Gorgas then adopted the same kind of anti-vector measures and eliminated yellow fever from the Canal Zone in Panama by 1906. These early efforts proved that a limited area could be rendered free of mosquito-borne infection.

One man who campaigned vigorously for the eradication of the mosquito from the world was an unusual American named Fred Soper, who was born in Kansas in 1893 and was educated at Johns Hopkins School of Public Health. He was a man of legendary energy endowed with great common sense. When thousands of larvae of the malarial mosquito *A. gambiae* were discovered in 1930 along a river in Brazil, thousands of miles from their homeland in Africa, Soper recommended opening the dykes damming the tidal flats, given that salt water destroys the breeding areas. But the Government refused, and malaria began to spread infecting 100,000 people, and killing 20,000 in 1938. The Brazilian President, Getulio Vargas enlisted the services of Soper to eradicate the mosquito – a kind of 'mission impossible'. Soper and his team of 40,000 workers fumigated houses and buildings with a natural pesticide Pyrethrum derived from the dried flowers of Chrysanthemum and sprayed Paris Green (a mixture of diesel oil and copper acetoarsenite) on pools of water. In just 22 months, he was able to eradicate the mosquito from an area of about 18,000 square miles in Brazil. Fred Soper's success was considered a great public health achievement in Brazil, and he was rewarded with medals and citations. This was before DDT was used in anti-malaria programmes.

The Swiss Company J.R. Geigy manufactured DDT (dichloro-diphenyl-trichloroethane) in the late 1930s. It was found to be the most effective insecticide against malaria, and hence used extensively during the World War II. Soper used it effectively to control the malarial mosquito *A. labranchiae* in Sardinia. His approach was described as having a 'zero tolerance' to the mosquito. Malcolm Gladwell in his article, 'In praise of DDT' (*The New Yorker*, 2001) referred to him as 'the General Patton of entomology'. Buoyed with success, Soper did believe that it would be possible to eradicate the mosquito from the entire world. The use of DDT helped reduce the cases of malaria in many countries including India and Sri Lanka. In India, DDT was sprayed widely even from elephant back. The low country dry zone in Sri Lanka was colonized using DDT manually. Agriculture was made possible largely through the control of *A. culicifaces*, which until then had crippled Sri Lanka's efforts to achieve economic self-sufficiency. In 1935 alone, some 20,000 people died of malaria in Sri Lanka. DDT was not only potent but also relatively inexpensive and so it was widely used. But the initial success proved illusory, for mosquitoes soon began to evolve strains immune to DDT. Public opinion began to turn against the use of DDT with the publication of *Silent Spring* by Rachel Carson in 1962, much to the dismay of Fred Soper. *Silent Spring* highlighted the plight of the environment under the impact of pesticides, and questioned the widespread assertion that DDT was safe. In aquatic environments, even tiny amounts of chemical pesticides are picked up by the smallest organisms, concentrated and passed along food chains to the larger predators through a process known as bio-amplification or food-chain concentration. It was from Rachel Carson that the general public learned that DDT was found in mother's milk and could accumulate in the bodies of their babies. The silent protest led to the growth of environmental activism. But as Malcolm Gladwell points out, nowhere in the book does Rachel Carson credit the efforts of malariologists in saving almost 10 million people through the use of DDT. In 1972, USA declared the use of DDT illegal, and listed it as one of the 'Dirty Dozen' Persistent Organic Pesticides (POPs). Spielman and d'Antonio believe that a worldwide ban on DDT would be a mistake, for if properly used DDT could provide great relief to the poor in the Third World countries. Of all the chemicals currently available to kill mosquitoes, DDT remains the ideal insecticide of first use. 'This', as Spielman and d'Antonio argue, 'is because the resistance that mosquitoes develop after being exposed to DDT does little to protect them against the other, more expensive insecticides that wait on the sidelines'. In December 2000, DDT was deproscribed so that it could be manufactured in China and India for use in anti-malaria programmes. Soper must surely be turning in his grave, for he died in 1975.

Despite the fact that countries such as Taiwan and Jamaica have eradicated malaria, it is unlikely that the diseases can be eliminated from the entire world in the near future. The emphasis is now on attacking the parasite with drugs. Quinine was developed from the bark of the Cinchona tree, known to the Indians in South America as 'quina-quina'. In Peru it grows at altitudes above 1500 metres where *Anopheles* mosquitoes do not survive. The natives use the bark to cure fever and chills. Malaria was unknown in the New World until it was introduced by the Spanish and Portuguese armies in the 16th century. According to Pedro Cintas, the Swedish Botanist Carolus Linnaeus, who first devised the binomial system for naming plants and animals, named the tree after the Countess of Cinchon, the wife of the Viceroy of Peru, who was said to have been cured of malaria by taking an extract of the bark. But it was the Jesuit priest, Calancha who learnt the bark's therapeutic value against fever and introduced it to Europe in 1633 as an antidote to malaria. Hence it is referred to as 'Jesuit's bark'. As Sandra Knapp points out, 'malaria is an Old World disease that was initially cured by a New World plant'. The alkaloid quinine was the first drug to be used widely in the control of the malarial parasite. However with the development of synthetic drugs such as chloroquine and quinacrine, dependence on 'Jesuit's Bark' became a thing of the past. Unfortunately, the widespread use of these drugs has also promoted the evolution of new strains of the parasite that are resistant to the drugs, while the application of pesticides has led to the evolution of mosquito varieties resistant to them. The US Army first encountered drug-resistant malaria when it got bogged down in Vietnam.

Malaria is not an easy disease to treat as it manifests several distinct developmental stages in both mosquito and man. Hence a vaccine designed to attack one developmental stage may prove useless against the other. In the words of Spielman and d'Antonio, 'the dream of a true vaccine remains elusive'. Today while billions of US dollars are spent on the international space station, very little money is available for the control of diseases, especially those that affect the poor in the Third World. Pharmaceutical companies that put profit over philanthropy are not interested in developing drugs for diseases that affect mainly the poor. But all this may change with global warming if malaria were to spread into parts of Europe and USA and strike the rich!

Andrew Spielman and Michael d'Antonio have produced a truly fascinating, highly informative and immensely readable book aimed at a much wider audience, about a tiny insect that more than any other animal on earth has so adversely and profoundly affected the lives of so many human beings for so long. You may not love the mosquito, but by the time you finished reading the book, you will not fail to develop a deep appreciation for the female of the species.

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The State of Food and Agriculture – 2002: Agriculture and Global Public Goods: Ten Years After the Earth Summit. FAO. Rome. 227 pp.

FAO's annual reports on the State of Food and Agriculture have usually three sections covering the current agricultural situation, regional reviews and some special topics of contemporary relevance. The 2002 report follows this pattern. Since 2002 marks the 10th anniversary of the UN Conference on Environment and Development held in Rio de Janeiro in 1992, two special topics have been chosen for detailed analysis. The first topic relates to the role of agriculture and land in the provision of global public goods, and the second, to carbon sequestration through land use change and its impact on rural poverty.

Globally, there were 815 million undernourished people in the world in 1997–99, of whom 61% live in Asia and 24% in sub-Saharan Africa. To achieve the goal set at the World Food Summit held in Rome in 1996, the number of undernourished people would have to decrease by an annual rate of 22 million. Progress in achieving this target has been very poor, with only about 8 million coming out of the hunger trap each year. Also, millions of people still need emergency food assistance as a result of natural and human-caused disasters. Other than parts of Africa, the countries facing serious food shortages are, Afghanistan, Iraq, Mongolia and North Korea. But for the emergency food provided through the World Food Programme, the death toll due to famine would have been high.

On the production front, the world cereal output in 2001 was about 1880 million tonnes, which represents an increase of 1.2% over the 2000 level. World cereal trade in 2001–02 is likely to be of the order of 236 million tonnes. World cereal stocks at the end of 2002 are likely to reach 587 million tonnes, about 8% less than the previous season's level.

The total world commercial fish production in 2000 was 130.25 million tonnes, an increase of 11.9% since 1995, reflecting enormous gains in aquaculture production, particularly in China. The Report provides regionally disaggregated data. Also, a CD ROM containing the Time Series data for SOFA 2002 is appended with the Report.

The Report also deals with issues relating to the renegotiation of the WTO Agreement on Agriculture (AOA) based on the agreement arrived at the Ministerial meeting held at Doha in November 2001. If trade is to become not only free but also fair, it is essential that the discussions on the revised AOA take into consideration the following issue: It is well known that OECD countries provide subsidies to the extent of one billion dollars per day to their farmers. The USA has further increased farm subsidies in its Farm Bill of 2002. Obviously, these subsidies are being adjusted against Blue box payments and Green box measures. Their subsidies do not seem to fall within the purview of Amber box measures, which alone are considered to be trade distorting.

In the current Geneva round of negotiations, it may be useful to propose the following two alternatives: First, all boxes may be abolished and the do's and don'ts with reference to trade distortion and unfair trade practices may be spelt out in clear and unambiguous terms. Second, if the above is not acceptable, a fourth box relating to Sustainable Livelihoods (Livelihood Security Box) may be introduced, which will empower developing nations facing the challenge of providing livelihoods to the rural population to place restrictions on imports, where there is convincing evidence that such imports will erode job/livelihood opportunities in their countries. Since over 66% of the population of many developing countries including India depend upon agriculture (crop and animal husbandry, fisheries, forestry and agro-forestry and agro-processing) for their livelihoods, trade which leads to the destruction of rural jobs/livelihoods will further enhance poverty and hunger and will make the achievement of the UN Millennium goals in the areas of poverty reduction and hunger elimination, impossible. The result will be social disintegration because of a further increase in rich–poor divide. Globally, the continuation of the present situation where a few million farm families in industrialized countries, supported by heavy inputs of technology, capital and subsidy, compete with over a billion small farmers, having little access to technology, credit and adequate post-harvest infrastructure, will not help to make free trade an instrument of poverty eradication. Trade should not only be free but also fair to the primary producers in predominantly agricultural developing countries. The percentage of population dependent on agriculture for their livelihoods should be the major criterion for eligibility for using the provisions of the proposed Livelihood Security Box. The minimum could be 50% of the population.

On the whole, the main message of this Report is that the necessary political will and action to end hunger are still to emerge. Poverty and inequity are increasing. The goals set by Governments in inter-governmental conferences are not being achieved. If governments of developing countries continue to neglect their fundamental obligation to provide opportunities for a healthy and productive life to all their citizens, social disintegration and violence will grow. In this context, it will be useful to remember what the Roman Philosopher Seneca said 2000 years ago, 'A hungry person listens neither to religion nor reason, nor is bent by any prayers' Where hunger rules, peace cannot prevail.

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