An Interview with Graham White, Ph.D.

Graham White, Ph.D., is a research scientist in the Department of Entomology & Nematology, University of Florida, Gainesville, based in the Mosquito & Fly Research Unit of the U.S. Department of Agriculture-Agricultural Research Service Center for Medical, Veterinary & Agricultural Entomology. He graduated with a degree in entomology from Imperial College of London University and chose a career in public health entomology, specializing in mosquito biology and control. Dr. White received his doctoral degree from the London School of Hygiene & Tropical Medicine (LSHTM) for research to develop chemosterilant procedures (sterile insect technique) that were applied by USDA to eliminate Culex quinquefasciatus from a Florida island. During 1967–1972, he served as medical entomologist for the East African Institute for Malaria & Vector-Borne Diseases, based at Amani in Tanzania, investigating vector species complexes in relation to epidemiology and control of malaria, filariasis, and onchocerciasis. During the 1970s, he was Assistant Professor at the Institute of Pathobiology, Addis Ababa University, with a Wellcome Fellowship to study the Anopheles gambiae complex in relation to malaria control operations. He then became head of Medical Entomology at the British Museum of Natural History, from 1974 to 1979, where he specialized in biosystematics and served 20 years as a Director of the International Trust for Zoological Nomenclature. He returned to LSHTM as Senior Lecturer in Medical Entomology from 1979 to 1985, and served as a World Health Organization (WHO) consultant with national vector control programs in Cuba, India, Indonesia, Myanmar, Nepal, and the United Arab Emirates. During 1985–1997, Dr. White was vector control product development manager for Imperial Chemical Industries (ICI, Britain’s biggest chemical company) and then Zeneca Public Health. He contributed to the development of pyrethroid formulations for antimalaria house-spraying and for insecticide-treated bednets, including the first wash-resistant treatment. In 1987, he founded the quarterly research journal Medical & Veterinary Entomology for the U.K. Royal Entomological Society. He served as entomologist and Rapporteur of the Technical Advisory Group of the Global Programme for the Elimination of Lymphatic Filariasis and has advised on malaria vector control in more than 30 countries. Dr. White was Rapporteur for a series of intercountry meetings that launched the WHO Integrated Vector Management Strategy 2003. Since 2004, he serves as full-time consultant for the U.S. Armed Forces Pest Management Board, to facilitate the development of new vector control materials and application methods.

VBZD: Dr. White, looking back at the decisions and experiences that contributed to your current research interests and career opportunities, what led to you to study entomology and to choose a career in public health specializing in mosquito biology and control?

GW: I was born in Britain and grew up in London. I was always interested in biology. Being a compulsive biologist from an early age, encouraged by my parents who ran a pharmacy, I began raising and selling exotic Lepidoptera during my schooldays.
During the 1960s, while the Stones and Beatles changed our music culture, I read entomology and zoology at the Imperial College of London University. It never occurred to me that there was anything else worth doing. Among my tutors I was fortunate to have the charismatic Dick Southwood (Sir Thomas Richard Edmund Southwood) whose name many readers will recognize as the author of trend-setting textbooks on insect ecology. But I turned away from academic ecology in favor of applied biology; my easy choice was to prefer medical instead of agricultural entomology.

While attending the London School of Hygiene and Tropical Medicine (LSHTM) for my Ph.D. and receiving support from a postgraduate scholarship from the U.K. Medical Research Council, I was offered a range of medical entomology projects to consider by Professor Douglas Bertram. I chose to work on the genetic sterilization of mosquitoes using chemosterilants as alternatives to radiation for producing sterile males to prevent reproduction, control the mosquito population, and prevent disease transmission. This approach, known as the sterile insect technique (SIT), had been developed by Ernest Knipling and his team in the U.S. Department of Agriculture (USDA) during the 1950s and 1960s, and had become renowned for eliminating the screwworm fly from North America. It continues to be a successful strategy for controlling various pests. Thanks to the generosity of Don Weidhaas, my professor was able to get samples of experimental chemosterilants from the USDA lab in Gainesville, Florida, for me to use in my Ph.D. project, which involved comparing SIT methods and materials. Later, the Gainesville team applied my pupal treatment method of chemosterilization to eliminate an island population of Culex quinquefasciatus. So it is remarkable that four decades later I am now talking to you from those same USDA labs in Gainesville, where I have been employed as a consultant since 2004, coming full circle to the center of origin of my career.

The highlights of my early experiences in the 1960s and 1970s related to the *Anopheles gambiae* complex, the most dangerous vectors transmitting malaria and filariasis in Africa. It had been shown by Professor George Davidson at the LSHTM that *A. gambiae* consisted of a number of species that were biologically distinct—genetically unable to interbreed. Some of these species were more dangerous vectors than others, so it was important to be able to distinguish in the field between what we called species A, B, and C in those days; I subsequently described species D in Uganda, which was feeding on pygmies in the jungle. Later, we designated them as *Anopheles gambiae* sensu stricto, *A. arabiensis*, *A. quadriannulatus*, and *A. brazzai*, respectively. We needed to determine what to do about each of these vectors. This presented a huge opportunity for me to move from vector biology and control into the genetics of speciation and behavior. The question I wanted to answer was, “If there are several species of *Anopheles gambiae* that are genetically and behaviorally distinct, how does each contribute to disease transmission?” The contrasts were very clear, but no one else was exploring this at the time.

The different species look exactly the same, which made it clear that species do not need to be morphologically different to behave differently. This led me to determine that one species in particular was aggressively biting humans—the species we still today call the true *A. gambiae*. One of the other species, *A. quadriannulatus*, did not even bite humans; it preferred animals and stayed outside of the houses. Often, countries would try to battle all of these species, even after they had successfully eliminated the most dangerous one.

After I had spent 6 years in Kenya, Tanzania, and Uganda, I went to Ethiopia to look at this problem in terms of a national malaria control program. Other parts of Africa at that time had no active program to control malaria. I had funding from The Wellcome Trust that allowed me to differentiate the responses of each member of the *A. gambiae* complex to spraying with DDT, which was the control strategy being used then. What we called “indoor residual spraying” was eliminating the vectors in the highlands of Ethiopia, but the non-vectors were hanging around and making people uneasy. We used genetic methods to differentiate the species, and I was able to tell the government that the vectors were gone in the highlands and that they could switch their efforts to the lowlands, where the vectors were still around. But their response was, “It’s much more difficult down there, so we’ll make a great job in the highlands.” That was truly astounding to me!

By moving from job to job I have been able to take advantage of opportunities that have given me more chances to achieve my career objectives. Clearly, for example, if you were a European working in Africa in the 1970s, you knew you would have to make way for the growth of the local scientific fraternity. That is why I left Africa after 8 years of enjoyable, productive work in the field, and took what might seem like a total contrast, a position in taxonomy at the British Museum of Natural History. But at that time I was at the frontier of how we understood species, and the British Museum hired me to apply that approach and assigned me the role of heading up the medical entomology activities of the world’s biggest museum that looks at classification and taxonomy. Because this work went so well, I was recruited back to the LSHTM for teaching and researching such matters.
Britain went through a great transformation during the 1980s, under Mrs. Thatcher as Prime Minister, and it became almost a national compulsion in Britain to work in industry rather than in government. Not unexpectedly, I found that commercial companies that made pesticides were piling us up with work at the LSHTM, testing insecticides for vector control. I became the contact person for handling contracts with companies that wanted data from an academic center to help them determine which insecticides to use and at what doses. I found myself getting offers from industry and it seemed the natural thing to do to join the biggest British chemical company, so I went to work for Imperial Chemical Industries, ICI, in 1985. During that time, I was getting assignments to return to the tropics and give advice, and it was a pleasure to work as a consultant based with a British employer. That is how things stayed until I retired for the first time. The British have a tradition of early retirement, and they make you retire when you reach a certain age. So I became a consultant for various agencies during the 1990s.

VBZD: You are currently a consultant for the U.S. Department of Defense’s Armed Forces Pest Management Board, with responsibility for the research program on Deployed War-Fighter Protection from disease-carrying insects. What does this position entail and what are some of the main problems you help to solve?

GW: Initially I received more offers than I could possibly travel the world to fulfill, mainly advising governments how to intervene against vectors and how to develop a successful national campaign. Then the United States Department of Defense Armed Forces Pest Management Board gave me some tasks while I was living in France and working at WHO headquarters in Geneva. After a couple of rounds of specific projects they proposed a full-time position working in the United States and placed me with the USDA. There is a program called the Deployed War-Fighter Protection Research Program (DWFP; www.afpmb.org/dwfrresearch.htm), for which the Pentagon provides $5 million per year. Collaborators that receive these funds are developing better tools for vector control, specifically to protect the deployed military against vector-borne diseases. I was called in to help get this program started in 2004, and my contract has been periodically renewed.

In the DWFP program, we know that everything we do to protect the military from vectors in the desert or the jungle may be applicable for protecting the public as well. President Bush created the President’s Malaria Initiative (PMI), and Laura Bush strongly advocated this program, funded at $1 billion per year to focus on malaria control in 15 African countries. With the merging of interests in the United States, we have the military and the Centers for Disease Control and Prevention helping this initiative in Africa. All of the candidates for the presidency in this latest election, including of course President Obama, committed to continuing this initiative. It is quite striking that the new Secretary of State Hillary Clinton has been advocating continuation of the PMI, allied with new Global Health initiatives through the U.S. Agency for International Development. There is now a growing movement in this country pushing for greater vector control in the most difficult parts of the world. I am glad to be here at this time and to be part of such efforts.

When I worked for the chemical industry, developing, registering, and marketing insecticides for vector control, I became part of the movement away from the DDT era and into the modern business of vector control, using pyrethroid insecticides for house spraying and impregnating bednets. From my position at ICI, I was able to provide samples of pyrethroid insecticides to the researchers developing these treated bednets. The concept of sleeping under a net to protect oneself from biting insects is a 2000-year-old idea. It is baffling why it took so long to think of putting an insecticide on the net, so that a mosquito that touches the net will not survive. The invention and availability of pyrethroid insecticides, which are reasonably safe for humans, arose during the 1980s, and the WHO recognized that the research on insecticide-treated bednets represented a very appropriate approach to vector and disease control, especially for communities that might not have many resources or much scientific training. In the beginning we encouraged villages to have treatment centers at which they would re-treat nets with insecticide.

Some of the early studies of this approach reported amazingly successful results. For example, in one community the reduction in mortality of infants and young children in the first 5 years of life, the age group at particularly high risk, was greater than 60%. The outcome of a subsequent series of studies done in the 1990s, which were coordinated by the WHO Tropical Diseases Research Program, showed that the use of pyrethroid-impregnated bednets by communities in malarious places reduced the incidence of malaria tremendously and led to large declines in mortality. Thus, by the end of the 1990s, it became dogma that everyone living in malaria-endemic countries should have access to and use insecticide-treated bednets. The main challenge now is how to get long-lasting insecticidal bednets at no cost to the communities that need them.

VBZD: What types of research projects are you pursuing at the University of Florida, Gainesville, where you are based in the Mosquito & Fly Research Unit of the USDA-Agricultural Research Service Center for Medical, Veterinary & Agricultural Entomology?

GW: As I mentioned, I am very lucky to be part of the DWFP program that receives $5 million in funding from the military to look for new, better ways of vector control in deployment situations. The main efforts are implemented by USDA labs of the Agricultural Research Service. One priority is combating phlebotomine sand flies that transmit leishmaniasis, as well as a wide range of problems with mosquitoes and filth flies. I am not doing the research; I am a consultant to this program, helping to facilitate projects for which researchers seek funding.

The DWFP program has funded 40 competitive awards so far for a wide range of projects. The priorities are to find new classes of insecticides that can rapidly kill adult mosquitoes, due to fears of resistance developing to existing chemical control agents. We have been making satisfying progress against mosquitoes, but we remain very puzzled about sand fly control in deserts to prevent the transmission of leishmaniasis.

VBZD: Based on your extensive work as a consultant for various agencies advising governments, organizations, and
public health staff doing vector control, from a global perspective, how successful have eradication and disease control efforts been and how can they be improved?

GW: It is really not difficult to achieve effective vector control if you have suitable tools and adequate training and resources. There is a lot of anxiety that malaria, leishmaniasis, or other diseases may be impossible to control. In general, especially for malaria and even dengue, if you get the public on your side and you have the right tools and can apply them properly, I firmly believe that any vector control problem can be stopped quickly. Getting everyone to line up and join in is the part that is hard to do. The public tends to think that vector control is the government’s job, while the government tends to think that the public is just in the way. But I know from personal experience that when you intervene sufficiently against vectors with the available technologies and strategies you can stop transmission of malaria within 2 or 3 years. But that is not widely appreciated because most people only have a limited window of knowledge or experience.

One good example would be Vietnam, where things had been left to rot after the Vietnam War. The Vietnamese government began to invite international collaborators, and the British ambassador that went to Hanoi encouraged British chemical companies to go into Vietnam and do business. I was able to go there to spray against malaria transmission in various valleys in North Vietnam. Not only did we stop malaria transmission, but we could not even find any vectors—they disappeared. It was so simple, mainly because we had the cooperation of the government and the people.

VBZD: What techniques and strategies now in development offer the most promise, and why? What technological barriers or obstacles to implementation need to be overcome to support the development of novel, more effective control strategies?

GW: I would like to answer that paradoxically by saying that the proven, old-fashioned approaches, especially for malaria vector control—eliminating the sources of mosquito breeding sites, use of insecticidal bednets, house-screening, and indoor-spraying with residual insecticide—are so powerfully effective in most places that all we need are more cost-effective tools and strategies for doing these things. We know they work well. And the SIT offers the ultimate solution, with RIDL sophistication described by Luke Alphey in your journal’s recent interview (Glaser 2009).

Reference


—Interview by Vicki Glaser