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# PROFESSOR CHRIS F. CURTIS — A MEDICAL ENTOMOLOGIST WITH INNOVATIVE VECTOR CONTROL STRATEGIES

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## ABSTRACT

The life and works of Prof. Dr C.F. Curtis are discussed, with special reference to his contribution to Indian mosquito research and their control.

## INTRODUCTION

The life of Professor Dr C.F. Curtis, an inexhaustible medical entomologist and a genius non pareil, truly reflects the spirit radiated from Robert Frost's inspirational and vivacious message:

> *Who comprehends his trust, and to the same Keeps faithful with a singleness of aim;*

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*And therefore does not stoop, nor lie in wait For wealth, or honour, or for worldly state;*
*Whom they must follow, on whose head must fall, Like showers of manna, if they come at all.*

He was one of those rare scientists who by their energetic character not only practically educated the budding researchers in habits of industry, but by the example of diligence and perseverance which they set before them, largely influenced the scientific activity in all directions (SNOW & RAMSDALE, 2008; TYAGI et al., 2008).

**Fig. 1.** Prof. Dr C.F. Curtis (1968 – 2008).

Prof. Curtis was one of the world's leading medical entomologists, and most of his professional life was devoted to the development of low-technology methods for mosquito control. In the field of malaria control, his work helped establish insecticide-treated mosquito nets as a dominant technology for prevention and control of transmission. His influence as a teacher has been even greater: he gave lasting inspiration to countless students, and there is still a worldwide community of students and colleagues who are linked by what Prof. Curtis taught them about how to do science, how to value it and how to enjoy it. He was an ever-shining star of our medico-entomological galaxy.

## EARLY ENCOUNTERS WITH MOSQUITOES

Prof. Curtis was born on September 25, 1939. He was completely dedicated to the cause of useful science in the service of practical public health. Even during his PhD on "*A study of basic genetic mechanisms in fungi*", he was looking for useful applications of this work, and came up with the idea of using chromosomal translocations as a method of genetic control. He went on to develop translocations in tsetse flies, which are especially vulnerable to this form of control because of their low fertility, and then to work on the genetic control of mosquitoes in a World Health Organization research unit in Delhi, India. Due to precarious reasons, when the project was precociously closed, Prof. Curtis joined the London School of Hygiene and Tropical Medicine in 1976. In London, he began working on various forms of "appropriate technology for mosquito control", which would remain the focus of his research for the rest of his life.

## NOVEL TECHNOLOGIES

These technologies emerged from a simple idea for control of *Culex* mosquitoes, which carry the disfiguring disease lymphatic filariasis and breed in places such as pit latrines, soakage pits and flooded basements. The idea was to use loose beads of expanded polystyrene (the white plastic spongy packing material) to form a self-sealing layer on the water surface and suffocate the larvae. The first field trials of this method, designed by Chris and carried out by colleagues in Zanzibar and Dar es Salaam, produced several world records: emergence of more than 20,000 adult female *Culex* mosquitoes from a single pit in a single night was prevented; breeding in a pit latrine was prevented for more than seven years by a

single polystyrene-bead treatment; and, better than 98% reduction in adult mosquitoes from community-wide application to all the breeding-sites in a village.

Since the 1980s, Prof. Curtis's main research focus has been on practical methods for controlling malaria vector *Anopheles* mosquitoes, especially the use of insecticide-treated nets (ITNs). He led some of the very first work using experimental huts to study the entomological effects of ITNs and how they work to control malaria transmission. From then on, his work continued to promote and inform the development of this technology, as it gradually moved to centre-stage as a means of practical malaria control. Much of this was concerned with the "mass effect" of ITNs. When ITNs are used by most people in a village, there can sometimes be a "mass effect" on the local mosquito population, reducing its ability to transmit malaria and give extra protection to everyone in the area, including those without nets. This has implications for the way that ITNs should be distributed. His team originally predicted this effect, and were the first to demonstrate it in the field and to confirm the mechanism that mediates it. He himself developed this concept into a political argument in favour of "free nets" - the principle that donor funds should be used to give ITNs free of charge to everyone in the target population. Prof. Curtis became a tireless and highly influential campaigner for this cause, and against the notion that nets should be sold, or should be targeted only at the sub-groups more vulnerable to malaria (especially small children). In doing so, he contributed (with many others) to a significant strengthening of political will in developed countries, and thus to a truly vast increase in donor-funding for malaria control. Now, about 50 million treated nets have been given away for free in the way that he promoted, preventing tens of thousands of deaths due to malaria among African children.

In the process of this research, Prof. Curtis was also responsible for introducing numerous techniques - mostly methods of evaluating interventions - that are now considered standard. He was also a rigorous and highly regarded theoretical scientist, and produced simple models of genetic control in insects, and the evolution of resistance to insecticides. These were back-of-an-envelope style models, but they proved to be remarkably durable in their influence because of the way they identified and explored the practical weaknesses as well as the theoretical strengths of bright new ideas.

## UNPARALLELED LIFELONG PERSEVERANCE, FOCUS AND DEDICATION TOWARD MOSQUITO CONTROL

No account of Prof. Curtis's research would be complete without some mention of the way he went about his work, which is one of the reasons why he has been so influential. First, he was invariably straightforward, never over-elaborate. Second, he was always the skeptical scientist, rigorous and careful. He had a luminous integrity that sometimes bordered on the naive: you could never suspect him of falseness or pretension of any kind. He was modest: although he worked productively and effectively with colleagues from many disciplines all over the world, he never assembled a big research team, and was invariably careful to give the primary credit to his collaborators, assistants and field teams.

## DR C.F. CURTIS, INDIAN MOSQUITO RESEARCH AND THE CENTRE FOR RESEARCH IN MEDICAL ENTOMOLOGY

Dr Curtis was associated with the much-fancied genetic control project on mosquitoes commenced in the 1970s under the title of "Genetic Control of Mosquito Unit", run by the World Health Organization in collaboration with Indian Council of Medical Research (ICMR), Ministry of Health, Government of India, and worked in close company of Dr P.K. Rajagopalan and Dr V.P. Sharma, just to mention a few scientists engaged. Unfortunately, the GCMU Project was aborted midway due to some extraneous reasons and he returned to England. The GCMU Project, however, produced several significant research publications. Subsequently, Dr Curtis visited Centre for Research in Medical Entomology (ICMR), Madurai in 1992. During this brief visit, he introduced the rather young CRME scientists to his highly successful experimental trial with the expanded polystyrene beads for the control of *Culex* breeding in Africa. This prompted CRME scientists to explore possibilities of employing this low-cost technology in rural areas of south India where *Cx. quinquefasciatus* is the principal vector of bancroftian filariasis, too.

Dr Curtis's love for Indian research and scientists was well understood, and he continued to correspond with colleagues spread in ICMR institutes/centres. Thus, in 1981, when Dr V.P. Sharma, then the Deputy Director & Officer in-Charge of Malaria Research Centre (now rechristened as National Institute of Malaria Research) developed a WHO/TDR-funded research project on "Studies on development of malathion resistance in *Anopheles culicifacies* in south Gujarat", in

collaboration with Dr S. Pattanayak, Director, National Malaria Eradication Programme (now rechristened as National Centre for Vector Borne Disease Control), which I headed as the Senior Research Officer in-Charge, at Ukai (Talluk Songarh, District Surat), it was only the duo of Prof. Dr C.F. Curtis and Prof. Dr G.B. White who were chosen as the expert adviser to the project. I made several research publications out of this significant project which helped me secure a permanent position as Senior Research Officer in the ICMR-Vector Control Research Centre (now rechristened as National Institute of Vector Control Research), in 1984.

With an initial success of this trial, under watchful guidance of Prof. Curtis, a large-scale project was subsequently planned during 2007. In order to finalize the objectives of the research programme, Prof. Curtis later visited the CRME during November 2007, as a part of a high-level Expert Team comprising Prof. Graham B. White, Prof. C.P. Ramachandaran, Ms. P.J. Hooper, Dr. V. Kumaraswamy, Dr. D. Ramaiah, R. Rajendraan, Dr I.P. Sunish and Dr B.K. Tyagi (Director in-Charge, CRME), to finalize a research proposal with the funding by Bill & Melinda Gates Foundation (BMGF). To see is to believe as it was a sheer delight watching him advocate so strongly for the use of vector control technologies, of course in conjunction with the MDA, in the global endeavours to eliminate filariasis. The CRME proposal finally won funding from the BMGF, to the tune of Rs. 2 Crores. Prof. Curtis was a great source of inspiration and would always be remembered for his constant help to all who sought it.

## POST-EMERITATION ENGAGEMENT

Although Prof. Curtis retired in 2003, he continued his usual classroom teaching. In fact, he was busy with his students' project works when he fell sick suddenly, never to return to classrooms. He died unexpectedly on 13th May, 2008. There is a remarkably large community of people, scattered across the world, whose work and lives have been given lasting inspiration by Prof. Curtis's kindness, integrity, compassion and commitment. His influence as a figure of inspiration may in the end prove to be even more important than his contributions to science. For example, Fig. 2 only explains the depth of his passion for research; feeding on self the lab-cultured mosquitoes as a step to prepare for his experiments — right in front of his protégé and admirer, the young Dr Sajal Bhattacharya, at the London School

of Hygiene & Tropical Medicine, UK, in 2004. This instance reminds me about one of my own experiments on testing a repellent activity of the *Cymbopogon travancorensis*-extracted essential oil against vector mosquitoes (*Aedes aegypti, Anopheles stephensi* and *Culex quinquefasciatus*) while, in my laboratory at Centre for Research in Medical Entomology, Madurai which I was also heading as the Scientist 'G' & Director in-Charge, I was encompassed within a mosquito net with freshly emerged, 2-3 day-old, and blood-thirsty 100 female mosquitoes of a particular species, to quench their thirst on my bare upper body. Potentially repelling any mosquito species straight for 4 hours, and developed in several formulations, I named the anti-mosquito repellent as "*MosTyag.*" I presented the results of "*MosTyag*" at the ICMR's Scientific Advisory Board Meeting as well as the CRME's Scientific Advisory Committee Meeting.

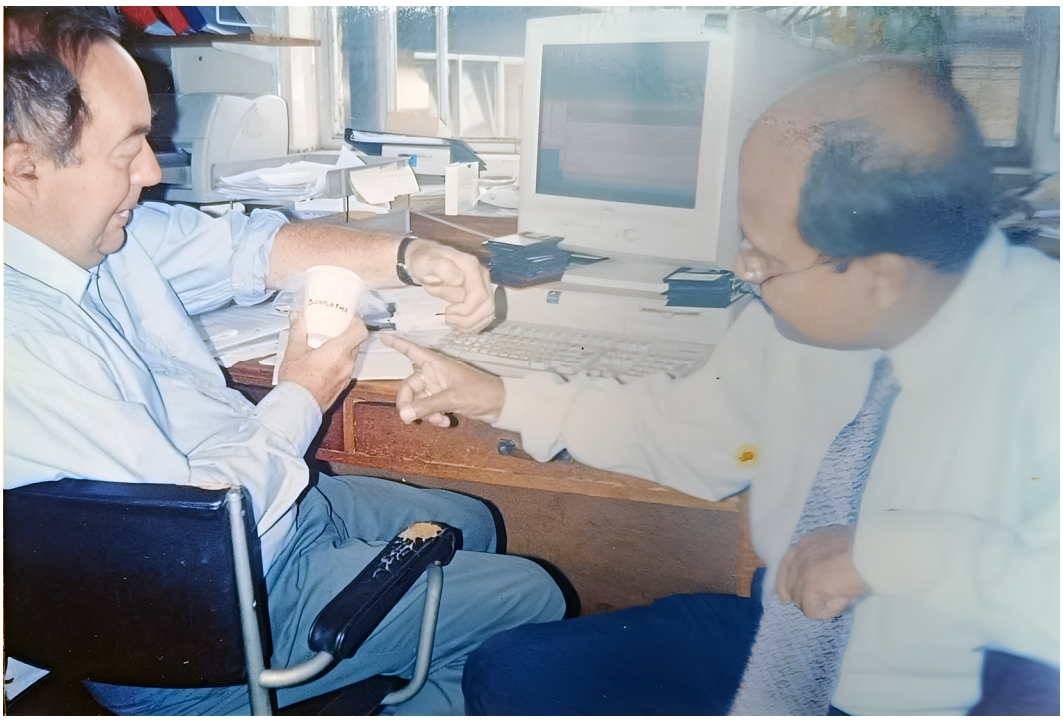

**Fig. 2.** Dr C.F. Curtis self-feeding to cultured mosquitoes, assisted by Dr Sajal Bhattacharya at the LSHTM, UK.

Dr Curtis was an epitome of hard work and ceaseless energy, never leaving for tomorrow the work of today:

*"The woods are lovely, dark and deep*
*But I have promises to keep,*
*And, miles to go before I sleep,*
*And, miles to go before I sleep."*

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