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Short Article

Malaria Remains Unshaken and the Mighty Mosquito Remains Unbeaten

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I N F O

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I N T R O D U C T I O N

Fighting malaria has very little to do with the intricacies of science and biology. The key was learning to think like the men hired to go door-to-door and stream-to-stream, killing mosquitoes. Do you think we should think like a mosquito? No, said Fred Soper, who eliminated Aedes aegypti from Panama Canal Zone and Anopheles gambiae from Brazil. His method was to apply motivation, discipline, organization, and zeal, in understanding human nature to achieve the objectives. This was the crux of the malaria control programme. He was considered the General Patton of Entomology. If any Indian can be compared to Soper, it can be only T. Ramachandra Rao.

Many stalwarts from India and abroad had done excellent work on malaria control. But I would like to single out the contribution of Dr. Paul F. Russel and Dr. T. Ramachandra Rao, in India, for strongly founding the revolutionary malaria-management tactic based on Mosquito Ecology. Russel, from the International Health Division of the Rockefeller Foundation (IHDRF), along with TR Rao, who started his career as Medical Entomologist under Russel in 1936, did pioneering work for six long years from 1936 to 1942, in villages of Pattukkottai in Tanjavur Dt, Tamil Nadu, long before DDT came into use. It is worth remembering that their work formed the basis for the anti-mosquito strategy in later years. Working from a rented house in Pattukkottai, they systematically surveyed populations of mosquitoes in differently managed agricultural fields; and examined the spleens of villagers in selected villages every year. As a part of their investigations, space spray with Pyrethrum extract mixed with Kerosene was done in all houses in one village with the aim of killing adult mosquitoes. Numbers of inflamed spleens, an indicator of malarial infection, dropped from 68 to 6% in the sprayed village over three years, while in the unsprayed villages, they remained steady at above 50%. Their finding was rated outstanding by the Rockefeller Foundation (RF) which had funded these studies, and the world at large. They also carried out a long-term program of mosquito-larvae control by filling in pits, creating better drainage and water-control devices in rice fields, distributing mosquito larva eating fish (Gambusia) and spraying Paris Green (a potent rat and insect poison).

A Sanitary engineer, Knipe, joined them and they focused on the design of appropriate spraying device to spray on adult mosquitoes in houses and on larvae in stagnant water bodies. What started as a routine mosquito control programme turned out to be a well-executed research event that bears immense impact on mosquito management in India even today? Most importantly they demonstrated the role played by stagnant water bodies in mosquito breeding and how irrigated agricultural fields act as reservoirs of mosquitoes. The people of Pattukkottai villages experienced a remarkable relief because of pyrethrum spraying, and which won an immediate and whole-hearted acceptance. Every householder welcomed the 'spray man'. People rejoiced the freedom from mosquito bites, from fevers, and from other plaguing insects such as bedbugs and cockroaches (and scorpions). Nearly 45 years later, sometime in 1980s, I again studied the malaria situation in Pattukkottai, where malaria was once controlled by Russel and Rao. I found that people still remember the good work done by the Rockefeller Foundation, and malaria had come back following the pattern in the rest of India, though on a lesser scale! The work of Russel and Rao actually laid the foundation for formulating later malaria control operations in India. Another landmark incident was that in 1942, at the time when the Rockefeller Foundation wound up the work in Pattukkottai, the then Governor of Bombay, and Sir Roger Lumley developed malaria after a tour in the District of North Kanara, then in Bombay State. At Delhi, he told the Viceroy, Lord Linlithgow, his concern at the prevalence and intensity of malaria in that area. The Viceroy, who was also greatly interested in malaria control, sent for the then Director of Malaria Institute of India (Sir Gordon Covell), who put forward proposals for a permanent malaria organization for Bombay Province, which were immediately accepted by the Governor. Dr. D. K. Viswanathan, who was serving with the Army on the Burma front, was asked to take charge of the new organization. He was an awe-inspiring personality known for his dynamism. Ramachandra Rao, after completing his stint with Paul Russel at Pattukkottai, had joined Bombay Government as Entomologist under Dr Viswanathan. The team of Viswanathan and Rao (like Russel and Rao before) did yeoman service to control malaria, as it was their work which led to starting a national programme. It was in the villages of Yellapur in North Kanara the efficacy of indoor residual spray with DDT was demonstrated for the first time in India, in 1944-45, resulting in drastic reduction of malaria. There was also this very interesting episode worth quoting here. When a large amount of money was demanded for spraying operations in North Kanara District, Sir John Lumley, the Governor, was hesitant saying that North Kanara District had not contributed much to the war effort. Viswanathan and Rao argued that the British Navy owed a lot of gratitude to the district, since all the valuable teakwood trees from the district (Yellapur, to be precise) have been cut and sent for building ships for the British Navy, denuding the teakwood forests completely. Immediate approval was then given for the field trial of indoor residual spray with DDT in Yellapur. (This incident was quoted by the late Dr. T. R. Rao himself when I was working as his Research Assistant many decades ago in 1953).

From the outset control efforts were directed to the destruction of the adult mosquito. Spraying with pyrethrum insecticide, which had proved of value in preliminary experiments in southern India (and Delhi), met with only partial success, but the introduction of DDT in September 1945 resulted in a dramatic fall in malarial incidence. Operations were eventually extended so as to cover the whole of Bombay State, which had a population of over 30 million. In his book Malaria and its Control in Bombay State [Bulletin, 1951, v. 48, 305] Viswanathan described how a nation-wide malaria control programme for India would be a worthy objective to get American aid. All entomologists and malariologists should consider this as Bible. In December 1952 an agreement was signed between USA and India. Viswanathan played a prominent part in these negotiations. Without this financial aid from the U.S.A. the National Malaria Control Programme, later to become one for total eradication in India, could not have been implemented. The striking success of the campaign led by Viswanathan and Rao in Bombay State not only resulted in the adoption of a nation-wide programme for India, but also gave impetus to similar schemes in many other countries. The rest is all history. Malaria was drastically controlled in 1960. I am quoting all these because the present-day scientists and malariologists should know about Dr. T. Ramachandra Rao, the great Malaria Entomologist who worked for malaria control, nonstop, from 1936 to 1952. (He left in 1952 to join the Rockefeller Foundation led Virus Research Centre in Pune, as Chief Entomologist, to establish studies on arthropod vectors of arboviruses. He returned to Bombay Govt. two years later to continue his work on malaria. His name is being immortalized here. I am proud to have started my career as Medical Entomologist in 1952 under this illustrious scientist and it was the initial training and guidance, I got from Ramachandra Rao that had seen me through in later life and career).

There is another very interesting episode worth mentioning that in 1958, while studying Public Health at the University of California, Berkeley, there were many stalwarts like Karl F. Meyer (Zoonosis), Fred Soper and Lewis Hackett (malariologists) as visiting professors. India had started the malaria eradication programme just then. In the open class, Hackett (who described spleen rates as an index of malaria measurement) laughingly talked about our India's malaria eradication programme, and wondered how anybody can

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ever think of eradicating malaria, where the parasite as well as the vector mosquito had evolved long before man! He was talking about the word Eradication. These were prophetic words. Dr Hackett was also malaria advisor to the Czar of Russia before the October Revolution, 1917, i.e. a Century ago. At that time quinine was the only antimalarial drug. He had asked at a parade of soldiers where the Czar was also present, that all should take quinine mixture before going to bed. Next morning, they again met and the Czar was also there. Since quinine produces luminescence in the urine and he asked for urine samples and the first sample from the Czar. The Czar himself had not taken quinine because of the bitter taste. He told the Czar, "Your majesty, you should have set an example for the soldiers for taking quinine, to control malaria". He narrated another story about the Spanish American War in Far East in 1899; A few battalions of soldiers were led through marshy territory breeding mosquitoes in the Philippines and all died due to malaria and the Americans lost the territory. This happened one year after the discovery by Ross, and how knowledge rarely reaches the field in time. He humorously ranked intelligence as Human, Animal and lastly military "in that order! This was in a class where there were quite a few Military officers sitting in the front! Those were the good old days when knowledgeable scientists were respected and obeyed.

What happened during the "DDT Era" and afterwards is all history. Malaria was once controlled drastically, and then in the later years of 1960s Malaria came back with a bang. And we are still grappling with the problem, even if it is of not that intensity. There are many pockets in India where malaria cases and deaths are occurring, in spite of best efforts. In quantitative terms they are in thousands (World Malaria Report, 2018). A malaria-free India now appears to be a dream. Malaria control at the national level has always been an operational programme, with the motto, which during the initial days of indoor residual sprays with insecticides, Spray and Pray! Due to deficiencies in the control operations at that time, the mosquito developed resistance to D.D.T. and later also to some other insecticides. This serious problem could have been corrected in time, if only there was constant entomological surveillance and research. A.P. Ray, the architect of India's successful malaria control programme, who could be compared to Fred Soper, due to the euphoria created during the early 1960s in controlling malaria, could not foresee vector adaptation to chemical pressure. Insect resistance to chemicals was not well known at the time. He thought that there would be no further need for entomologists in mosquito control work, and many were diverted to other operations or had their services terminated. This was the greatest tragedy. We are still paying the price for denigrating the role of Entomologists. Even now it is said that more than 50% of the sanctioned strength of Entomologists have not been filled. Qualified, trained, knowledgeable and field-oriented Entomologists are a rarity in India now!

Another reason for malaria resurgence was that all other methods of malaria control, suggested by Russel, Rao, and many others, were totally neglected at one time as they did not seem to be necessary at all. Many naturalistic methods of environmental manipulation demonstrated by Hackett in Malaysia (Please see Hackett's "Naturalistic Methods of Malaria Control"), by Russel and Rao, and many others in India, were not given much importance. Malaria research came practically to a standstill. There did not seem to be any more need for the Indian Journal of Malariology, one of the foremost journals on malariology in the world, and it stopped publication. The situation had become unmanageable with the number of malaria cases showing an upward trend. We plodded along, following WHO advice, and many innovations were suggested and implemented haphazardly. But even in recent years, our track record on malaria control doesn't exactly inspire optimism. The disease has been a low political priority for many years, rendering the current malaria control programme ineffective and confusing to implement. No one even knows exactly how many Indians suffer from malaria, let alone die from it each year. A couple of years ago the government claimed only about 300 deaths from malaria, while the British Health Journal - The Lancet reported 50,000 deaths taking place annually.

Even Indian officials acknowledge that there are severe limitations to the official statistics that depicted steady progress on fighting the disease, but claiming that new malaria cases dropped by half between 2000 and 2014. There was large scale fudging of data on malaria incidence which stems from the early days of the National Malaria Eradication Program, in which officers would lose their jobs over poor health outcomes. There was a report in 2016 (Economic Times, or was it Al Jazeera) of a situation in which every worker in the program was living under constant pressure from his or her supervisor .The false data collected thus gets forwarded through the District and State level, to the national level where a rosy picture is usually painted to the national Health Ministry, and these finally gets sanctified at the WHO level. The situation has not changed even now, assertions to the contrary notwithstanding! While working on tribal Malaria in Odisha in 1980s I found that there were some villages which were never sprayed due to either remoteness or hostility of the tribal population and many hamlets were never even visited by the control teams, and therefore no malaria control worth the name ever took place. A research team of Vector Control Research Centre found a few cases of P. malariae and P. ovale (Identification confirmed at London School of Tropical Medicine) in addition to many cases of P.

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falciparum and P. vivax. These findings were so embarrassing to the District Collector, that one fine day the VCRC team was expelled from the area! Such problems were also highlighted by Dr. V. P. Sharma, the founder- director of the National Institute of Malaria Research in an interview before his death in October 2015. His famous words: "You can never reform the present system because you're saying the problem isn't even there". There is also the problem of increasing occurrence of diseases like Japanese Encephalitis, Dengue and Chikungunya, obscures real malaria incidence and therefore which draws greater attention and support from the government. Consequently, malaria control no longer has any priority. At one time malaria overshadowed diseases like Dengue in wrong diagnosis and now it is the other way around, Dengue obscures malaria diagnosis.

Malaria Epidemiology abounds in instances where even a few gametocyte carriers present in a locality can become a focus (a micro focus perhaps) for transmission. It should be recognized that while one or two cases in a population of 10,000 may appear a low figure, even the one or two cases if they occur in a small circumscribed locality, say an isolated cluster of huts with 100 people (e.g. a tribal settlement), can be a serious matter. There is no more intense follow up surveillance any more. I know personally of several instances in a place (Borigumma, Odisha) where active transmission of malaria was going on in practically closed cycles in small outlying hamlets consisting of a few huts, while the main village itself, not more than a kilometer away, and was considered to be in a satisfactory position. These small insignificant-looking foci, sometimes undetected, sometimes detected but not fully liquidated, became centers for focal outbreaks, if the vectors were not under control. And there were just no competent entomologists or surveillance workers to monitor the problem in the field.

Malaria, therefore, can never be eliminated from India in the near future as there is no more infrastructure at present to handle such problems. Active surveillance, the key to success, is just not there. The situation cannot be compared with the achievements of several small countries in the neighborhood like Sri Lanka, Malaysia, etc. which have controlled malaria. The vastness of the country, with many different ecological zones, and varying cultural and political differences make it almost impossible to have a uniform pattern of malaria control in India. Also, health is a state subject and the National Control organization cannot enforce their writ strictly on the States. Area specific action plan could have probably achieved better results. But then, we in India depended more on advice from International Organizations, ignoring the examples set by Fred Soper (in Brazil), Lewis Hackett (in Czarist Russia), Paul Russel and our known our own T. Ramachandra Rao. Many years after his retirement, Dr. Rao was very disillusioned. He was one of the few great malariologists alive in the 1980s and told the Union Health Minister what was wrong with the National Control Program and asked for a National Malaria Commission! Malaria Control operations had also become a scam then! He was called senile by the then administrators! Dr. Rao opined that you take a donkey with a foreigner's label to the minister and when it brays, it becomes expert advice! The control set up even now does not function properly. As recently as March 2018, one scientist visited Kalahandi district, Odisha state, a hot spot of malaria, where he asked a ASHA worker about RDK (rapid diagnosis kit) and anti-malarials. She replied that for the last six months there were no RDK and antimalarials. Then he met the female health worker and asked about supply and she also said there is no supply of RDK and anti-malarials. He was shocked and thinking about malaria elimination returned to District HQ. He then met with the District Malaria Officer who agreed that there is a shortage of anti malarials and RDK in district. The supply was not given by the State. He tried to meet the state programme officer but she was away in Cuttack. "If we think about malaria elimination then we have to change our mindset and have qualified staff at each level, arrangements of logistics and funding and above all political will for malaria elimination". In another village he asked a householder about LLIN (Long Lasting Insecticide Impregnated Net), as the Government had distributed freely all LLINs. The lady of the house pulled out a new LLIN from a bag. LLIN distribution rate was 100 percent and user rate was Nil". There were also many other problems. In some places even microscopes are not functional or unavailable, nor there are technicians to do the job? The operational deficiency is glaring. Some of the technicians in areas where malaria is not rampant have even forgotten to identify the parasites! They should be given reorientation training. In most of the remote areas where the bivalent Rapid Diagnostic Kits (RDTs) are in use, quick diagnosis and treatment is never possible because of the time lag between blood slide collection (BSC) and their examination (BSE). So, there is no treatment. Some of these bivalent kits do show false positives. Then there is non-availability of the drug to ensure prompt treatment. There is no coverage or proper spray of insecticides; also, no trained staff to spray or supervisory staff to oversee the vector control operations anymore. The biggest tragedy is the absence of qualified and competent entomologists, to tackle the mosquito angle which is the most important aspect of Malaria Epidemiology. In 1980, VP Sharma started many Integrated Disease Vector Control (IDVC) units in several locations in India where malaria continued to be a problem. I think this was his greatest contribution to malaria control in India. There was special emphasis on environmental control. Many of IDVCs became centers of excellence not only in controlling Malaria in those areas, but

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these also turned out several young malaria entomologists. Eliminating malaria is, and should be, a priority for the country, but grand pronouncements are meaningless as long as manipulated data distort our knowledge and bad governance impedes genuine attempts to fight the disease.

India's malaria efforts lag behind those of most Asian and African countries. Over 90 per cent of national spending on malaria control in 2014 went towards administrative costs, salaries, and expenses other than the nets, medicines and insecticide sprays that make a concrete difference. The average global spending on administrative costs and salaries, meanwhile, is just 35 percent. The new malaria elimination policy does include some promising measures, like a greater emphasis on community participation in fighting malaria. The National Vector Borne Disease Control Programme (NVBDCP), which coordinates the malaria programme, said there is a study underway to better measure the number of malaria deaths. They also agree with the need to fill the empty slots on health staffs, and train and incentivize community health workers. India would need to invest a much larger chunk of its domestic budget in overall health care. And the interventions would have to step outside the realm of the government health model. As Health Ministry officials point out, some challenges are not in their hands. We lacked will power and administrative skills - the kind that allowed India to tackle polio. It is a tall order to implement. Malaria strikes the hardest in the Northeast, in places like Bastar in Chhattisgarh, or Koraput in Odisha that are already torn by internal disturbances. Ultimately, it can only be eliminated once the people in these areas are included as participants in the country's development who can hold the state accountable to them. That would require greater transparency from the government, and a focus not on its global image but instead on the actual people dying across the country every single day. Malaria elimination is really doable by a good leader who needs the courage and political influence to make it happens overcoming political pressure. It is unfortunate that we in India have a "we know everything" and big brother attitude, and are hesitant to learn from examples set by smaller countries. Also, the National Vector Borne Disease Control Programme, as the name implies, has the responsibility for the control of other diseases like Japanese Encephalitis, Dengue, Chikungunya, etc. and therefore they cannot devote much attention for malaria at present.

Swaziland, a very small country within South Africa, eliminated Malaria: "All cases were investigated within 48 hours. Trained personnel carried out vector control linked to case investigation and routine vector surveillance as well as established sentinel vector surveillance sites including insecticide resistance monitoring. Can such operations be carried out in many pockets in different states in India where malaria is a problem? Vector control guidelines should be revised in line with the requirements of elimination and the programme should implement and monitor Indoor Residual Spray where necessary after every spray round. The supply chain system especially the distribution of malaria commodities needs strengthening as well and a training programme started for malaria case management, microscopy as well as malaria diagnosis. We have to ensure community participation in public health programmes as this was identified as necessary for the elimination agenda. A much smaller country like Sri Lanka, which did all these, was declared by WHO as having eliminated malaria. The determined effort made by countries like Sri Lanka, Malaysia, etc. to implement the various control measures is really admirable. None of these is happening or even possible in India, which is comparatively very large with varying ecological conditions and political set up. They have more problems at hand running the organization and which can be summed by what Sir Gordon Covell, the first director of Malaria Institute of India said "I spend only 10% of my time fighting malaria, but 90% of my time fighting people preventing me from fighting malaria!"

What about research, which should be on a continuing basis monitoring every aspect of malaria control? One reason is the "molecularization and computerization" of malaria research since 1980s, in almost all institutions dealing with vector borne diseases. The importance shifted to white apron clad scientists working within the four walls of an air-conditioned laboratory fitted with computers! We followed the WHO example in the eighties when the famous Vector Biology and Control (VBC) division was renamed Molecular Entomology Division. What is the connection between molecules and vector control work in the field? It was market-oriented research, funded by multinational companies, and foreign universities (seeking raw material for their research work), which are now the core funding source of the Research Programme in our research bodies. Field work in India had long become out of fashion and meant occasional visits to the field, which Barcelato, a Scientist with the Tropical Diseases Research Programs, called Safari research. Apron clad laboratory "Scientists" replaced hardcore field workers. We really need 'boots on the ground' attitude of working in the field. We are looking for Easy solutions to complicated epidemiological and ecological situations in computers. What is actually required is Applied Operational Research in the field. Only papers with high impact factors are now produced, to improve the career prospects of the investigators, and none of them giving easy, practical and sure solutions for real malaria control. There are many experts (all retired and superannuated personnel and some with no knowledge of the subject) - a wit calls them ex-spurts, but no malaria workers. Efforts should have been made on how to apply known technologies to practical use in the field. How to

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make the personnel actually do the job they are supposed to do. First get malaria under control in the country by tackling operational problems faced by NVBDCP, before carrying out publication oriented theoretical academic research to advance your career (Can we call it survival research - rather not picking research of no importance?). Most of our young scientists may not have heard the contributions of great malariologists like Fred Soper, Lewis Hackett, Paul Russel and others. I wonder whether they know even our own Ramachandra Rao's classical work.

It is sad that researchers in many research institutes have wrong priorities. Many are keen in by molecular biology, but then and as Prof. A. Raman of Australia puts it, today's molecular approaches are like 'recreating' organisms in the cyberspace and treating them as models to work on to solve real-life problems." We are informed of things that none can see, perceive, and visualize. Many of today's biologists speak in terms of outcomes that are unverifiable and untestable. I think all these need to be pitched on sound logic and sequenced, rational, convincing evidences - the very foundation of science and scientific approach. It is also sad that such an approach is being prescribed as a substitute for every kind of problem in India for which solutions have to be found only through hard field work. Wilbur Downs said while molecular studies-for example vaccine development is fascinating. Some of the new scientific approach is also illusory. They deflect attention from the here and now. The "here and now" is that today there are millions of people in thousands of villages for whom the application of knowledge and means already at hand - an adequate supply of antimalarial drugs, simple control procedures carried out on the local problem, and differentiation of malaria from other diseases and efficient mosquito control - is still awaited. These are the "here and now" problems which had taken a back seat.

Many easy solutions are offered based on cage experiments, and without understanding anything about what happens actually in the field conditions, but have no buyers in many countries. On release of genetically modified mosquitoes as a magic solution to control malaria, Dr. Ify Aniebo, a Nigerian molecular geneticist and malaria specialist, who is skeptical about the approach, wrote in November 2018 and quoted in Scientific American: "Africa doesn't need genetically modified mosquitoes. Dr. Aniebo's first concern was the speed with which the technology is being deployed. More studies on GM mosquitoes need to be done, she says, "to ascertain safety and avoid unintended consequences before releasing them into the field. African countries do not have the infrastructure needed to regulate or solve any problem that may arise from this technology.., It's worth noting that a careful analysis of the GM mosquito releases that have already taken place – in the Cayman Islands, Panama, Brazil and Malaysia, suggests that the claims of success made for these trials are not actually supported by the evidence." Just how top-down the genetic engineering approach is can be seen in the case of the research group behind the release of the GM mosquitoes in Burkina Faso. "Target Malaria is largely based in London – at Imperial College – and has been funded to the tune of over $75 million by the American billionaire Bill Gates, via his Foundation in Seattle. This follows a pattern seen in others of the Gates Foundation's activities – that is supposedly helping the world's poor it spends the bulk of its money on high-tech approaches in rich developed countries. The deployment of such a highly experimental technology in Africa is justified by its backers on the grounds that there are no viable alternatives for adequately combating malaria. But, in reality, there are plenty of less drastic ways to fight malaria says Dr. Ify Aniebo. She points, for instance, to "sanitary engineering; getting rid of mosquito breeding sites; and swamp drainage" as some of "the interventions that have helped in the past and have proven to be sustainable solutions" (The same objectives Russel and Rao had in 1936). She asks: Why spend such vast sums "on developing genetically modified insects when the money could be directed towards environmental engineering projects that hinder the ability of mosquitoes to breed in the first place?" This kind of long-term approach should not be ignored if we are serious about combating malaria, she says. In fact, these "more conventional tools" cannot only reduce malaria but even eliminate it – Sri Lanka, eliminated malaria-without resorting to genetically modified mosquitoes. Even in the age of drug resistance, some countries have still managed to attain [malaria] elimination status." Several countries in Africa like Nigeria, Uganda, Swaziland and some others have done far more advanced work not only in Applied Research and their commonsensical, practical and economical approach to disease control. We have any number of low-technology ways to reduce mosquitoes and the diseases they spread. Personal protection measures, destruction of breeding sites in and around the home, fogging during outbreaks – all of these have an impact on disease incidence. The lessons of the Panama Canal (Gorgas) and Brazil (Soper), and many other smaller countries like Swaziland, Sri Lanka, and several others is that it does not take high technology to control mosquito vectors. Instead, political will, strict discipline helping sustained application, and constant surveillance, are what's needed to have real policy bite. For the foreseeable future, we have to manage mosquito-borne diseases through environmental, safe chemical and innovative drug therapies. People get lured by some exciting new discoveries, but before jumping on the band wagon they should ponder whether it is applicable in all cases. We have knocked our heads against this type of thinking long enough.

I must conclude by paying my tribute to the great Fred

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Soper, who spent all his life on Aedes aegypti control in Panama Canal Zone and An. gambiae control in Brazil and Egypt, etc. His name was synonymous with malaria control. Towards the end of his life, Fred Soper, met with an old colleague, M. A. Farid with whom he had fought successfully the malaria vector An. gambiae in Egypt years before. “How do things go?” Soper began. “Bad!” Farid replied, for this was in the years when everyone had gone against Soper’s vision. “Who will be our ally?” Soper asked. And Farid said simply, “Malaria” and Soper, he remembered, almost hugged him, because it was clear that malaria will remain unshaken. I as a medical entomologist and vector ecologist, have been writing and talking about problems faced in the control of mosquito borne diseases including malaria, at the far end of my life (now 89) and feel very much disheartened. I wish we had with us people like Fred Soper, Lewis Hackett and Ramachandra Rao, among others.

So, malaria will continue to be a problem in India for many years to come, though not in epidemic form, but widespread in many pockets in India. We have to live with it, along with many other vectors borne diseases. And the mighty mosquito will also continue to remain unbeaten. There seems to be no other way forward in the near future.

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