

A Journey Through the History of Medical Entomology in India-An interaction with Padma Shri Prof. Dr. P. K. Rajagopalan

DISTINGUISHED MEDICAL ENTOMOLOGIST SHARED HIS LIFE JOURNEY WITH DR. K.A. SUBRAMANIAN



When I received a phone call from Dr. V. V. Ramamurthy to interview Prof. P. K. Rajagopalan, I was thrilled and scared simultaneously. It was akin to the feeling of seeing Himalaya in close quarters with its full grandeur and towering heights. During my post-graduation days, I had met him briefly when he had visited Vector Control Research Centre, Pondicherry for an official meeting. Because of my interest in natural history, especially in birds and training in medical entomology I was familiar and admired of his classical epidemiological work on Kyasanur Forest Disease, Japanese Encephalitis and Filariasis. Dr. Ramamurthy had shared my contact details with Prof. P. K. Rajagopalan (PKR) and within no time, I got a phone call from him and he spoke to me as if we had known to each other for years with a grandfatherly affection. We immediately fixed an appointment and after two days later on 14th January, 2023 I met him at his residence in Thiruvanmiyur, Chennai. Before meeting him, I made a phone call and he give me a turn-by-turn instruction on how to reach his residence, which was of course far more accurate than Google Maps. Just before reaching his

residence, he called and told me that he is waiting for me on the road in front of his apartment so that I don't need to search. I was spellbound. He took me to his study, what stuck me was his ease with computers and social media. He will reply to your emails and WhatsApp messages within minutes. There was no structured interview but he shared his vast experience on vector biology and vector borne disease control spanning over 70 years with clarity and remarkable memory. I felt like interacting with a living library and history of Indian medical entomology unfolded in the next three hours of interaction.

Early Life

Prof. Payyalore Krishna Iyer Rajagopalan, well known among colleagues and friends as PKR was born in October 1930, in Mukteswar Kumaon, in the Himalayas, where his father was working as a veterinarian in the Imperial Bacteriological Laboratory. In 1935 he was shifted to his maternal grandfather's home at

Tattamangalam, a tiny village in the old Cochin State of present Kerala (now in Palakkad district) for school education. After completing school education at young age of little more than 14 years, he moved to Benares Hindu University (BHU) for higher education. He completed his B.Sc., and M.Sc. Degree in Zoology in 1951 with “First Class, and first in Order of merit”. The education at BHU in his own words

“I must confess that I did not learn anything to help me in eking out a future career. The whole system of education was faulty particularly in non-professional colleges at that time. In College of science, BHU, there were many departments apart from Zoology, like Botany, Chemistry, Physics, Geology, etc. All these departments were headed by learned academicians, but no one knowledgeable to teach the latest findings in science”. “To quote an example, though the exo-erythrocytic cycle of malaria parasite was discovered in 1940 or so, the post graduate students were not taught about this in 1950!”

Like many other post graduates in the department and in the absence of any other alternative, he joined the department as Ph.D. scholar working on a textbook oriented problems allotted by the professor. However, the library of BHU attracted PKR and he utilized the time to improve his general knowledge in many fields and large part of time was spent there. After two years of “research” at BHU he was called in May 1952 for a personal interview for the post of a Research Assistant in Entomology at the Virus Research Centre, Poona (VRC), a joint venture by the Rockefeller Foundation (RF) and the Indian Council of Medical Research (ICMR).

The interview at VRC in the words of PKR.

“Dr Austin Kerr, who had worked all his life on Yellow fever, was the Director of VRC. He along with Dr C.G. Pandit, the first Director General of ICMR, and a few others were in the selection committee. They asked about malaria – the only answer I knew (as taught by all the universities at that time) was about Anopheles mosquito as the vector of malaria. When they questioned me further, I was bold enough to ask “Which University teaches anything more about malaria? I was taught about evolution of the horses, elephants, structure of the insect, etc.” An Indian member of the selection committee considered my answer impertinent. But Dr Austin Kerr and Dr C.G. Pandit asked me to wait. In the end I was called again and appointed to the position. I was also complimented for telling the truth. Many years of frustration made me to call a spade a spade; I maintain these traits even now and as a result I am disliked by many, also admired, may be , by some, but never ignored, even today!”

KAS: Sir, can you give us a brief overview of your work at Virus Research Centre, Poona (1953-70)?

PKR: “I started my career as a Medical Entomologist (with the rank of a Research Assistant and a monthly pay of Rs.160/-) at the Virus Research Center, a new institute started by the Rockefeller Foundation and the Indian Council of medical Research in 1952. It was the luckiest break I got for starting my career – primarily because the Centre was managed by well-known American scientists from the Rockefeller Foundation. I was less than 23. My life in VRC was like baptism on fire. Earlier the

Rockefeller Foundation (RF) had done a serological survey in many places in India to detect antibodies to arbo-viruses, and the results were published in a paper by Smithburne, Kerr and Gatne. I think this paper was published around 1949 in the Journal of Immunology. The results had shown the presence of antibodies to several group B viruses. One of the main reasons for this survey itself was to find out why Yellow Fever, had not been reported as a disease entity in India. This then led to establishing a research center to study arboviruses. Dr J Austin Kerr, who was a well-known Yellow Fever expert, was the first Director. Dr Harold Johnson was the chief Virologist and Dr C. Brooke worth, the Medical zoologist. Dr T.Ramachandra Rao came on deputation from Bombay Public Health Department, as Medical Entomologist. Dr Austin Kerr was succeeded by Telford Work as Director, and it is no exaggeration that maximum development and expansion of the VRC took place during his time. Dr C.R.Anderson replaced him as Director. Like his name (WORK) he did work, very diligently. Dr Harold Trapido, who was responsible for controlling malaria in Sardinia, was the Ecologist. But the most knowledgeable and experienced scientist to join the VRC was Dr Jorge Boshell. He was a renowned epidemiologist and naturalist of world stature and had spent many years in the jungles of South America and I was privileged to work with him in the field for six long years, learning all aspects of ecology and epidemiology. I owe a depth of gratitude to Dr T.R.Rao, from whom I learnt Entomology, and to Dr Jorge Boshell., from whom I learnt ecology and epidemiology (particularly of arboviruses), and last and not least to Dr Charles Anderson who taught

me about *Integrity in Scientific Research which had stood me in good stead.*

The VRC in the early fifties wanted to find the presence and distribution of different viruses pathogenic to man and all its work was directed towards detecting arboviruses from mosquito, human and animal sources. First, we had to get the experience, and I had to learn all about mosquitoes and other Haematophagous arthropods. Apart from Dr T.R.Rao who taught me the ABC of mosquito taxonomy, there was no one else in the Entomology Section. Having led a frustrated life for two years in BHU as a “research Scholar”, I was determined to make it good in life. At the time, I don’t think I had any special aptitude for scientific research in particular. But I persevered. I, along with 6 other insect collectors cycled to different places, doing mosquito collections in the morning; in the afternoon identifying the mosquitoes, and preparing pools of different species for virus isolation. In the evening we did outdoor resting and biting (landing) collections at dusk, and returned by 10 p.m. This was a routine for several years. Can you imagine every day seven cyclists with kit bags cycling all the way to different places to collect mosquitoes? Our team was often ridiculed for our appearance. I learnt the subject the hard way. It was the best ecological study ever carried out by any one “on mosquitoes of Poona district” and the results published in *Indian Journal of Malariology* (authors: Rao and Rajagopalan) and it had about 70 or 80 pages. I was very proud of my first paper and my work was recognized by my bosses.

After Dr Rao left in 1954, I was made the “chief of Entomology section” while still a Research Assistant. Another few years of intensive field work in the rainy, leach

infested evergreen forests of Colaba and Ratnagiri districts of forests of Western Maharashtra, virtually enhanced my reputation as a field worker. I was then made head of a newly created Field Entomology Division. I was only 25 then, still a Research Assistant with a few scientists of higher rank working under me! Can you imagine such a set up in present day India? Field work was given the due status it deserved at that time and my hard work was recognized, appreciated and amply rewarded by my American bosses. I also took part in investigation of several fever episodes. I also gained a lot of experience by working on ticks and mites!

KAS: Can you explain us about your studies under taken in the tropical evergreen forests of the Western Ghats of Karnataka?

PKR: I must tell you about the detailed studies of a unique ecosystem undertaken in Devimane Ghat', in North Kanara District, Karnataka State, which was a virgin, tropical, evergreen forest. Very few people of the present generation know about this unique study. An ecological study (read ecosystem study) was undertaken to obtain evidence as to why yellow fever was not present in India. Devimane Ghat, situated on the Sirsi-kumta road in North Kanara District, was a typical virgin tropical evergreen forest, similar to deep jungles of Africa and South America where Yellow Fever was prevalent. A large plot of land on the road side located in the Ghat Road amidst forest surroundings was selected and cleared for establishing a Field Laboratory. Tents were set up with all facilities for lodging, and a laboratory. Kerosene operated Refrigerator and a generator was also set up. The entire operation was

financed by the Rockefeller Foundation. I was assisted by another Research Assistant named, Lamba: we also had the services of insect collectors, field workers and technicians, etc. We stayed there throughout the duration of the study which lasted for a little over a year. The program included collection of blood samples from human and animal sources, for serological tests and virus isolation. Arthropod collections from different habitats were also made. All collected material was sent three times a week by special couriers to the main laboratory at Poona, by road and train. Imagine the organizational set up and the logistics involved! I was handling the entire show. One of the main studies was on indoor and outdoor resting and man-biting mosquitoes, and their vertical distribution in the forest. Several tree platforms at different heights were constructed deep inside the jungle and biting collections were made throughout day and night for several months. Previously such a stratification study was done only in Trinidad and in Entebbe (Uganda). The entire planning was done by Dr Austin Kerr.

Unfortunately, these studies at Devimane ghat were abruptly terminated, since the personnel had to be moved to another area. The results of investigations from this study were yet to be analysed and published. Recently questions are being asked about the inter-epidemic cycle of Dengue and Chikungunya viruses and the possibility of the existence of a zoonotic cycle for both Chikungunya and Dengue. The results of studies in Devimane could have provided some lead to study and understand important the inter-epidemic zoonotic cycle of these two viruses. I had actually suggested a detailed study on these lines, and to include

large and small mammals like monkeys, rodents (as in KFD) and birds (as in WEE and EEE) in 2013. In depth studies must be undertaken on a long-term basis, similar to one undertaken by the VRC at that time, if one has to understand the ecology and natural history of several of the neglected and emerging tropical diseases, Dengue, Chikungunya, Scrub typhus, KFD, etc., so that a break can be applied in the chain of transmission. But now the focus is only project-oriented research and publications (with high impact factors) and not problem oriented research.

KAS: Your Investigation of the epidemic of Japanese Encephalitis (JE) in North Arcot District, Tamil Nadu (1954-57).

PKR: The reporting of Japanese encephalitis (JE) cases in Christian Medical College Hospital (CMCH) for the first time in India (1954) gave a shot in the arm to the VRC – AND JUSTIFIED ITS EXISTENCE. I am sure both the ICMR and RF (Rockefeller Foundation) were wondering what to do in India. For the first time since the VRC was established a vector borne viral disease was discovered in India. It was of enormous importance and the Rockefeller Foundation became involved. Most of the work was done by the entomology team (under my leadership) and Dr. Dandawate who was responsible for the virology. We started our working day at about 8 in the morning, collecting mosquitoes till dusk, later identified the species involved and prepared pools for each species. Many lakhs of specimens were collected, identified and processed for virus isolation. We finished each day's task late at night. We were encouraged very much by our Director, Dr Telford Work, who knew each one of us by name and occupation. An unusual

behaviour in a team leader at the time let alone these days. Our efforts were rewarded by the isolation of the JE virus from mosquitoes. The human angle was studied by Dr John Webb and Dr Sheila Pereira of the Pediatrics Dept of Christian Medical College and Hospital (CMCH) who did an excellent study of clinical history of JE (mostly in children). The mosquito vectors implicated belonged to the *Culex vishnui* group. The result of this monumental work was later published in an article, entitled "An analysis of mosquito collections in Japanese encephalitis areas of North Arcot District, 1954-57" and published in *the Indian Journal of Medical Research*.

I and my staff later moved to a field laboratory in Akivedu, West Godavari Dist, Andhra Pradesh, to study migrant birds coming to nest in the Colair Lake. This was a large lake formed by impounding Upputeru River in Eluru Dt. We lived virtually on boats, collecting mosquitoes, blood samples fledglings of migrant birds, mostly Grey Herons, nesting here. We collected Laelaptid mites parasitizing these nests. All material was sent to the headquarters laboratory for processing further. It was very hard life- we were living on duck eggs and canal water. We must have stayed for about 6 months there. Suddenly, my colleague, Lamba left to join the Zoological Survey of India (Dr. B.S. Lamba, who did many studies on breeding behaviour of Indian birds later). He was a great companion and good friend and I missed him as we worked as a team for about five years. The work in Akivedu was again terminated abruptly. All the staff then moved to Sagar, Shimoga District, and Karnataka State to take part in the investigations connected with Kyasanur

Forest Disease. As far as I know the results of the work in Akivedu also has not been published.

A decade or so later, I was summoned to investigate epidemics of JE in Tirunelveli (Tamil Nadu) and in Burdwan and Bankura Districts of West Bengal. In a way JE is environment related disease of seasonal occurrence. The epidemiology also varies somewhat in different places as the studies showed. The major vector, *Culex tritaeniorhynchus* breeds profusely in rain/flood water collections, is primarily zoophilic (feeding on animals) feeding on cattle – you can call this pullulator of mosquito population (as distinct from amplifier for which an animal (pig) or bird (Fledgling Ducks, etc). Drought conditions exist in many parts of India, followed by heavy rainfall, flooding and increased wet cultivation. It has been established that some species of migrant birds (e.g. Grey Herons) nest in these areas, bringing the infection.

Investigations on Kyasanur Forest Disease: Investigations on Kyasanur Forest Disease: (19570)

KAS: Can you elaborate on the discovery of Kyasanur Forest Disease (KFD)?

PKR: In March 1957, all of us working in Akivedu were again transferred to Sagar. Typical of the working style of the then Director, Dr Work, we received a 7 or 8 page telegram which virtually told us – to close Akivedu Field Station, keep all the unmovable laboratory equipment with the local hospital and move to Sagar (Shimoga) and giving details of the road route we should follow, since KFD (Kyasanur Forest Disease) HAD BROKEN OUT THERE! An epidemic of fever occurred among forest frequenting villagers in Shimoga District,

Karnataka State, coinciding with monkey deaths in adjoining forests in 1957. The etiological agent was a group B virus, belonging to Russian Spring Summer Encephalitis (RSSE) complex. The virus was isolated from humans, monkeys, questing ticks found on forest floor, from ticks collected as ectoparasites of several species of mammals and birds. The virus was more akin to Omsk Hemorrhagic Fever virus. Since its discovery, more than 25000 human cases and more than 7000 monkey deaths had been reported. The disease in man is fatal unless recognized early and treated symptomatically. Investigations showed the involvement of many large mammals and birds, several species of ticks, several species of small rodents, shrews and an insectivorous bat. A complex natural cycle of the virus had raised many questions. Why did the virus become suddenly active in the area? Was the virus introduced through migrant birds and their ectoparasites? What was the role of the monkey, cattle, birds, small mammals, and shrew and their ectoparasites in the natural cycle of the viral epidemiology? Was there a change in the biocoenotic relationship among the different aspects of the ecosystem? This was, (and even to this day) all very fascinating questions and attempts were made to answer them.

My stay in KFD area (for 13 long years) was the most stimulating, interesting and educative part of my life. It was like the ancient *Gurukula Vasam* (students spending life with their teachers in ancient India learning *Vedas*, music etc). I learnt a lot, took my higher degrees (M.P. H. from University of California School of Public Health, Berkeley and Ph.D. from Poona University). From a Research Assistant, I

rose to the rank of Assistant Director. *I even got married during this period!* The isolation of and characterization of KFD virus was memorable in one sense, it was the first time that the etiological agent responsible for a new disease was isolated and identified. There was a dead monkey hanging on the top of a tree in the forest; Dr Work was wondering how to bring the carcass down. I (I was only 27 then) climbed to the top of the tree, brought down the monkey carcass almost in fact; all the organs were harvested and KFD virus was isolated from every organ. Dr Work was so happy that he asked me (in March 1957) to soon get married and that he would be sending me (along with my bride) to the University of California, Berkeley, to study for a M.P.H. in Epidemiology! That was one of the greatest opportunities one could ever wish for. Before doing my M.P.H. at Berkeley, I worked for six months at the Encephalitis Laboratory at Bakersfield, Calif. The Unit was working on the Western Equine Encephalitis, under the direction of William C.Reeves (Professor of Epidemiology), who along with K.F.Meyer and W.Hammond, discovered WEE virus. Dr Reeves arranged that I should also get specially trained in Malaria (in 1958) under Lewis Hackett and in Zoonoses with K.F.Meyer at the Hooper Foundation for Medical Research at San Francisco, and other institutions. Before returning to India, I studied Ticks and Mites at the Institute of Acarology, at College Park, Maryland; and also underwent a four-week course in Ecology at the Bureau of Animal Populations, Oxford, under Charles Elton! On my return to India, I started working again on KFD. I had the proud privilege of working with two of the greatest stalwarts, Dr Salim Ali, the world renowned

Ornithologist, who guided me for my Ph.D. work, and Dr Jorge Boshell, a very famous epidemiologist and Naturalist. Dr Boshell had worked for many years on Yellow Fever in South American forests, and discovered the sylvatic cycle incriminating of the Yellow Fever Mosquito, *Haemogogus spegazzini* which was transmitting the zoonoses from monkey to monkey in the forest canopy! I had learnt a lot from him, I consider him my mentor in Public Health, Field Epidemiology and a host of other subjects. Not many had this golden opportunity to learn so many things in their career. There was not a field which we had not touched. They included Mosquitoes, ticks and mites, small and large mammals, both domestic and wild; birds, bats, and their ecto-parasites and most of all, the immensely important field of epidemiology of arthropod borne viruses. At the time, I also learnt a great deal about the how the forest ecosystem influenced the zoonotic cycles. IT WAS A CHANCE OF A LIFE TIME. It was an investigation of an epidemic with an unknown etiology and which could be followed as an example in many situations.

When the Rockefeller Foundation withdrew from the VRC, the KFD field station was soon closed down and many important aspects like wild animal and tick reservoirs of the virus, etc, yet to be studied. Scores of scientific papers were published during this period. The assignment at the VRC (1957 March to 1970 June) was my last one, as I was transferred to the WHO-ICMR project on Genetic Control of Mosquitoes at New Delhi.

My stay at the Virus Research Center (now it has been renamed National Institute of Virology) was one of the most enjoyable

and educational. I left as a fully qualified and experienced Public Health Entomologist and Vector Ecologist recognized the world over. I owe this to my association with some great scientists of the Rockefeller Foundation and to the doyen of Medical Research in India and founder Director General of Indian Council of Medical Research, Dr C. G. Pandit. No amount of praise would be too much for the way the Rockefeller Foundation ran the affairs of the VRC. They built from scratch an excellent Research Institution, with necessary infrastructure. They developed a cadre of scientists and got them trained at the best of Universities and Research Centres in different parts of the world. They encouraged them, and helped all to achieve higher goals in life, including getting higher academic qualifications. I was one of the luckiest, I may say. I had the opportunity to study the work on Dengue at Bangkok, Japanese encephalitis in Japan, Viruses at Trinidad Regional Virus laboratory, ticks and mites at Institute of Acarology at Maryland, many aspects of Eastern and Western Equine Encephalitis at various centre's in the united States; bird migration on an island (Williams haven//Bremerhaven) north of Germany; studies on yellow fever at East African Virus Laboratory. I also spent a lot of time with the British Museum (Natural History) studying taxonomy of Mosquitoes, Ecology under Charles Elton at the Bureau of Animal Populations, Oxford University, and with Harry Hoogstraal, US Naval Medical Research Unit, Cairo, studying ticks. etc. More than anything else, the training I received from many stalwarts like Drs. T.R. Rao, Harold Johnson; Austin Kerr; Harold Trapido; Telford Work, Charles Anderson; and the most important of all, Dr

Jorge Boshell at Shimoga for five long years, were very invaluable. Above all they gave me the confidence to think logically and speak authoritatively on many subjects particularly vector ecology and epidemiology which stood me in good stead throughout my professional and retired life.

KAS: Can you explain interesting experiments you carried out on genetic control of mosquitoes under WHO-ICMR Collaborative Research Unit (1970-75)?

PKR: In June 1970, I was transferred along with a few others to the above WHO project. I was appointed as Senior Scientist in charge of Ecology. This Unit was closed in June 1975 after a political controversy. Actually, the Americans wanted to use the accumulated PL-480-rupee funds in India and to spend it for experiments on mosquito ecology and dispersal and the results of which could be used for several purposes, including planning biological warfare. Whether the work was planned for this purpose or not, only future events would have shown. But the Unit was closed down abruptly.

Whereas the avowed object of the Unit was to control the vectors of malaria and Filariasis through genetic control methods, the major work was on the dispersal studies on mosquitoes including the yellow fever mosquito, *Aedes aegypti*. No work was done on *Anopheles* mosquitoes, the vectors of Malaria. While a lot of work was done on the Filariasis vector, *Culex quinquefasciatus*, the Delhi area was not endemic for Filariasis. Quite a lot of work was undertaken, which may not have any relevance to the control of filariasis, much less malaria. The Unit, which had to close down following a political controversy,

created a storm in the Indian Parliament, and was quite embarrassing to say the least, to scores of Indian scientists working there., The whole planning was by the United States Public Health Service; they signed an agreement with the WHO, and the latter signed another separate agreement with the Indian Health Department. This was a very unusual arrangement and controversial in the history of Indian Science. To detail the particulars here is beyond the scope of the present write up. This will also hurt several people in India and abroad. There was rivalry between three foreign participating groups, one advocating Chemosterilization and irradiation of mosquitoes, and another two groups advocating genetic manipulation Cytoplasmic incompatibility and genetic translocation. One of the groups published a news item in their embassy newsletter that the chemosterilant used for sterilization of mosquitoes thiotepa, is carcinogenic. This stirred a hornet's nest in the nationalist Indian press and one National daily wrote a big article. One of the leading science journalists (KSJ) came to investigate this. The WHO spokesperson (RP) at the GCMU, instead of explaining what is happening, tried to turn him away saying that the WHO policy did not allow giving any press interview! Investigations followed and an adjournment motion was tabled in the Parliament and after a heated debate, which was accepted. This was a unique instance in the parliament's history. Later two Public Accounts Committees (PAC) investigated the matter and finally recommended that the Unit should be closed down. The PAC also gave strict guidelines for research with foreign collaboration. (This regulation, I have seen, is followed more in finding loopholes I into it).

Before going into the scientific achievements of the GCMU, which was quite substantial, I must say what went wrong. The sterile male technique which was used was applied for the first time in mid-western United States, to control Screw Worm flies, which bored cattle skin, causing extensive loss for the leather industry. The females mate only once with the males (as also in the case of mosquitoes). Since there was marked difference in size between male and female puparium, they were able to mass rear the flies, separate all the males at the puparium stage, chemo sterilizes them, and release millions of such sterilized males in the population. The mated females laid sterile eggs and thus in course of time, the screw worm fly density was drastically reduced. This is called the sterile male technique. Some scientists wanted to apply this technique to control mosquitoes. Irrespective of whatever technique was used to sterilize the mosquitoes, done at the pupal stage, a 100 percent separation of sexes was not possible because there was not such distinct difference between the male and female sexes. There was always a contamination of 2 to 5 percent, at the time of separation of males from females. When millions of males are released, 100 to 200 thousand females are also released and which are human biting. This was biggest scientific flaw in the experiment. It was also found that the sterilized males, as well as the genetically manipulated males were not competitive with the wild males, and therefore the results were very disappointing. Added to this was the controversy over whether the chemo sterilant used, thiotepa, was carcinogenic or not.

But the main reason why a controversy erupted was because of the extensive work done on *Aedes aegypti* particularly the studies on dispersal patterns, and the plans to mass release them in an industrial township (Sonapat).

Scientifically speaking, however, five years of very extensive and intense studies were carried out at the GCMU and where several well-known International and national Scientists participated. Outstanding work was carried out on Ecology, Bionomics, Dispersal patterns, and Genetics of *Culex quinquefasciatus* and *Aedes aegypti*. The Unit also trained and produced a team of highly qualified and experienced scientists who ultimately formed the bulk of the Research Staff of three ICMR Institutes, (1) The Vector Control Research Centre in Pondicherry (VCRC), (2) The Malaria Research Centre in Delhi (MRC) and later the (3) The Centre for Research in Medical Entomology in Madurai (CRIME)

KAS: I am very much interested to know the history of Vector Control Research Centre, Pondicherry.

PKR: Unlike many Research Institutes, Vector control Research Centre (VCRC) was not planned to be established, and of all the places, in Pondicherry. Following a political controversy, the WHO-ICMR Collaborative Research Unit on Genetic Control of Mosquitoes (GCMU) had to close down its operations in Delhi in June 1975. Apart from a few WHO Scientists, the majority of whom were Indians and among whom only three or four had permanent positions at the Virus Research Centre, Poona, and who could go back to their old positions. All the rest would have lost their positions. It is due to the farsightedness of

Dr C. Gopalan, the distinguished Director General of ICMR at that time that he wanted to utilize the services of trained scientists, that the VCRC was established. There was no regular budget or program, except that since most of the scientists were entomologists and were working on mosquito control techniques at the GCMU it was decided to shift the staff to a new institute for vector control. Dr Gopalan decided to start a Field Division of the VCRC at Pondicherry. I, being a vector Ecologist, was appointed as its new head. At the same time a Laboratory division was also established at Delhi (in the campus of NICD) with the late Dr K.R.P. Singh, an experimental entomologist who was also from the GCMU, as its head. This was according to the directions given in the 200th report of the Public Accounts Committee of the parliament, as a purely temporary measure pending a final decision by an Expert Committee to be formed by the Government. The total budget per year for the two units was estimated at that time as Rs. One lakh, to be met from the left-over funds of the GCMU Until 1st April 1977. Both the field and laboratory units of the VCRC were functioning without a regular budget, or even a staffing pattern and several junior technical staff were recruited on daily wages. During the transition period (July 1975 to March 1977), Dr N. Veeraraghavan, retired Director of Pasteur Institute, Coonoor, was asked to look after the establishments pending a decision. The Governing Body of ICMR then made the VCRC a permanent institute under the Council from 1st April 1977, under my charge. (During the course of the following year, the laboratory division was separated into a distinct unit and named the Malaria

Research Centre (MRC) at Delhi, with Dr K.R.P. Singh, in charge. This is authentic story of how the VCRC came to be established. The entire credit for this development belonged to Dr Gopalan (DG, ICMR), who was a visionary in every respect, and to Dr T. Ramachandra Rao

I would like to mention here, that when the decision to move to Pondicherry was taken, many rickety old vehicles along with old furniture, and other laboratory stuff were moved by road to Pondicherry like a caravan with the only knowledge that they were expected to go to the Jawaharlal Institute of Medical research (JIPMER) a central Government post graduate medical institution. We were told to assemble under a tree to await further instructions!! Actually JIPMER offered only two rooms to establish the newly formed VCRC institute. I remember, the Lt. Governor of Pondicherry, Mr. Cheddy Lal, telling us that in Pondicherry, a small union territory, “we will be a PATCH whereas in any other part of India we will only be a DOT”. He was also good enough to arrange a huge old French style mansion, called Eni Bungalow, to establish our Institute. Subsequently one or two more buildings were also hired, so that some scientific work could be started.

Before regularizing the institute, from the April 1977, the governing body of the ICMR, gave the following guidelines and objectives:

“While the VCRC should have the opportunity and freedom of work to work on any vector borne disease as it became necessary, it needed however to concentrate on malaria and Filariasis as a matter of priority. Specific projects relating to vector control with scientifically based approach

was of utmost importance to enhance the management of the two major diseases. The design and execution of various components had to be accurate. Our approach was of immense practical significance, without a proper understanding of the vector ecology, the ecosystem in which the species operated, seasonality, and host preferences-it would have been difficult to predict the seasonal transmission patterns and the levels of disease endemicity”.

For any institution working on vector borne diseases, the above directions were like BIBLE. During my leadership of the VCRC these were our guiding principles. Every effort was made to stick to them as far as money and manpower allowed us to do.

From July 1975 to March 1977 was a period of stabilization and consolidation, and also a period for building to build up an infra structure for the new Institute. I had one senior scientist, the late Dr Reuben and four junior scientists (P.K. Das., P.K.B. Menon, and K.N. Panicker) to assist me, aided by several technical and laboratory personal already on the ground in Pondicherry. I had to recruit additional scientific and technical staff for the Center. I was able to fulfil the mandate of the newly established Research Centre with the encouragement and full support of Dr Gopalan.

Pondicherry at that time was highly endemic for Bancroftian filariasis, with the microfilaria rate of above 20%, and malaria in pockets of Pondicherry villages. But in neighbouring Tamil Nadu, in Salem District, there was *Anopheles stephensi* transmitted urban malaria and *A. culicifacies* transmitted riverine malaria. I opened a field station in Salem (with Dr Reuben in charge) to work

on urban and riverine malaria. Since filariasis was endemic in Pondicherry area, an extensive two year study was started on all aspects of Filariasis transmission. These studies were intended to provide entomological and epidemiological data, so that effective control measures could be planned. There was excellent co-operation from the Pondicherry health department and from Tamil Nadu state dept of public health. I must mention here that Dr V. Sambasivam, Director of Public Health,

Pondicherry was a great source of help and support on all matters connected with the VCRC, including giving land on long lease for construction of a new building for the VCRC. Similarly, Dr V. Kapali, the director of Public Health, Tamil Nadu and Mr A.V. Ganesan, the then Chief Entomologist of Tamil Nadu offered unstinted support to the VCRC for its work in Salem and later in Rameswaram, where island malaria was highly prevalent. These studies were taking place simultaneously in these places and the local health departments were helped by the VCRC in controlling malaria. Several papers have been published on malaria control.

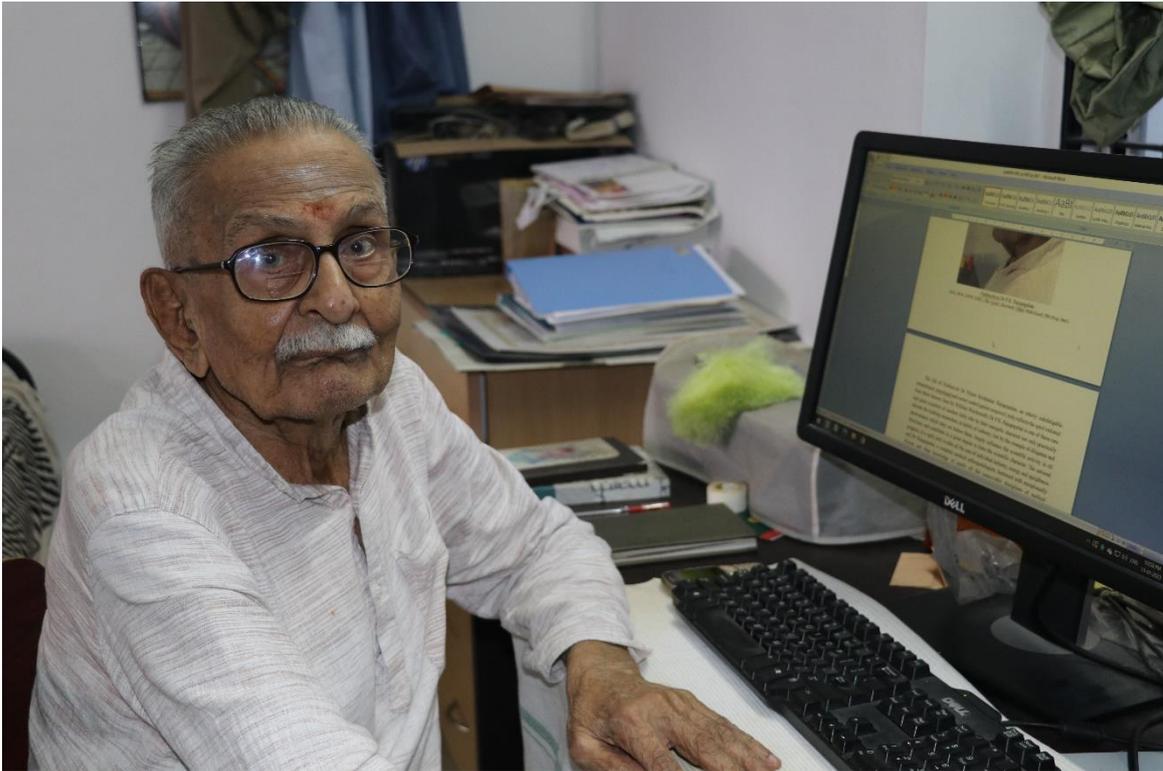
It must be mentioned here that in the late seventies, when I was in Pondicherry, there was an outbreak of Japanese Encephalitis (JE) in Burdwan and Bankura districts of West Bengal, and Dr Gopalan wanted the VCRC to investigate. The work was done with the collaboration of the School of Tropical Medicine, Calcutta, where the materials collected were tested for virus isolation/antibodies. A significant finding was that *Culex bitaeniorhynchus* played an important role as vector of JE in certain situations, and that fledgling ducks could also harbour the virus and act as amplifiers in the absence of pigs. Subsequently, the

VCRC team led by me also investigated JE epidemics in Tirunelveli District of Tamil Nadu, where the epidemiological situation was similar to North Arcot District, which was also investigated by me as part to the team from Virus Research Centre in 1954-55. In my opinion, a significant and unique work, relatively small in magnitude, was carried out by Dr Panikker in Pudukkuppam, a coastal village in Pondicherry, where malaria broke out in epidemic form among the fishermen community. On investigation it was found that a sea water breeding mosquito, *Anopheles subpictus*, where algae was found, was the main vector. In fact, the mosquito breeding depended on the presence of algae. By motivating the community, algae were removed regularly and the local Aurobindo Ashram made handmade paper out of it. It was a profitable venture for those involved and vector control became a commercial venture on a sustainable basis and malaria control was achieved. This was technology in action. This actually became a sort of guideline for future vector control operations and followed very successfully in Shertallai, a technology-based mission project to control Brugian Filariasis.

Coming back to urban Bancroftian filariasis the massive data collected during the two-year study showed that the high microfilaraemia in the population was due to very high biting density of the vector, *Culex quinquefasciatus*, breeding profusely in open drains and that drastic reduction in mF rate could be achieved by controlling mosquito breeding to a significant level. The basic studies carried out were unique, and were patterned after the studies in Rangoon carried out by Hairston, DeMeillon, Jacobski and others. I cannot think of any

other study in India or anywhere else similar to this. These findings were utilized for control of filariasis. A five year *Filariasis Control Demonstration Project* was launched in January 1981 in Pondicherry and was inaugurated with great fanfare by the then Union Minister for Health, Shankeranaand, and presided over by the Lt.

Essentially, we had planned the project on the pattern of Fred Soper's *Aedes aegypti* eradication project in the Panama Canal Zone to control yellow fever. Dr P.K. Das was put in charge of this project, with special funding liberally sanctioned by the then DG, Prof Ramalingaswamy. I was given full freedom to operate with full



Padma Shri Prof. Dr. P. K. Rajagopalan working in his residence

Governor of Pondicherry, and attended by Prof. Ramalingaswamy, DG, and ICMR.

The then Prime Minister of India, Smt. Indira Gandhi, sent a special message. The campaign was planned following Fred Soper's work in Panama Canal Zone, *"It was not a campaign that introduced new techniques, but a campaign that illustrated what could be accomplished by application of already known techniques, and applying them more vigorously than ever before, coupled with political sagacity and bulldog tenacity"*.

support and with no interference. The project attracted worldwide attention and was visited by experts from abroad. For the first time integrated methods of vector control was used on such a large scale. Many people ridiculed the venture. But Dr Ramachandra Rao, the famous malariologist, gave us support and encouragement which we badly needed, by writing to me—

"The integrated control and environmental are most important developments. However, they will require a

lot of dedication and hard work. If successful, as they are bound to be, they will be new watershed in our battle against vectors...They will undoubtedly be expensive in the beginning and will attract adverse comments. Already, some people call it utopian, but all new developments appear to be utopian“.

The project was a great success and the results, already published, showed that it is not necessary to eradicate mosquito breeding (which is impossible in Indian urban situation) to eliminate filarial infection, but if the biting density of the vector could be drastically reduced by integrated control methods we could achieve a drastic reduction in microfilarial rate in the community. At the end of the five-year period, there were only three microfilaria cases in children under five years age! The most important by-product of these studies was the creation of a highly trained cadre of young scientists. In trying to tackle Bancroftian filariasis in most urban situations, it is worthwhile remembering what Sir Ronald Ross said, and I quote

Great is sanitation, the greatest work, except discovery, I think, that a man can do...What is the use of preaching high moralities and policies...to people who dwelling in appalling slums..? You must wipe away those slums, that filth, these diseases...We shall reach the higher civilization, not by any the politicians' shibboleths ...and the rest, all of which have failed-but first by the scientific ordering cities until they are fit for men of the higher civilization to dwell in. We must begin by being cleansers“. I was able to show that Ronald Ross was absolutely correct, when we demonstrated success of his methodology in Pondicherry.

Follow up Investigations five years after completion of the clean-up operation produced dramatic results. It showed (1) that Filariasis transmission was reduced to negligible levels and very few new cases of microfilaria carriers were found, and, (2) in spite of the very poor infrastructure in Pondicherry, integrated vector control methods did result in a drastic reduction of mosquito population. This was a no mean achievement, and the outcome was applauded by both the people and government of Pondicherry. It was also concluded that (3) in urban areas with poor sanitation and infrastructure, it was not necessary to completely eliminate the mosquito population; even 60 to 70 percent level of reduction in biting mosquito density can be achieved mostly by environmental sanitation and manipulation, and which could dramatically reduce the disease transmission rate in an overcrowded urban population. A low level microfilaraemia in the population can be adequately treated by that wonder drug, Di Ethyl Carbamazine (DEC), used very successively all over the world, either singly, or in combination with other antihelminth drugs, or medicated with common salt.

In Rameswaram Island, where drug resistant *P. falciparum*, was being transmitted by *Anopheles culicifacies* breeding in innumerable pits where water was being stored for watering coconut plantations. Also, the behaviour of fishermen frequently moving from place to place became accidental carriers of the malaria parasite and spreading the infection to other communities in their travels. A team of brilliant scientists lead by Dr Jambulingam, Dr Sabesan and others unraveled the modus operandi of the disease transmission and

their results were published in the British journal, *Journal of Social Sciences*, at the request of its editor, who also wrote a forward to the article. This island was contributing to more than 20% to all malaria cases in the whole state, and the Tamil Nadu Health Department used it as a model for their malaria control programmes.

After attaining its objectives, the field station was closed five years later. This study enabled the Centre to train a large group of young malariologists. Dr Jambulingam was transferred to an assignment to study tribal malaria in Koraput, Orissa, and Dr Sabesan to Shertallai in Kerala, to study *Brugia malayi* transmitted Filariasis. The Shertallai studies proved a great success; it demonstrated how people's participation could play a role in successfully managing the disease.

The Koraput Station, in Orissa, was started in 1985, with Dr Jambulingam in charge. It was a difficult working terrain populated by a tribe of unsophisticated Naxalites. Malaria due to *P.falciparum* and *P.vivax* has been persistent in this region for many years. A young lady doctor, Dr Govardhini was appointed to attend to all health needs of tribal women including gynecological care. This helped the VCRC to gain the confidence of the tribals. The team did a lot of excellent work, including the finding of several cases positive for *P.malariae* and a few cases for *P.ovale*. This field station was the pride of VCRC because of its contribution to help malaria control in tribal area. Under the dynamic leadership of Dr Jambulingam, excellent long term ecological studies were carried out. A brilliant piece of work was by Dr Gunasekharan, whose studies on *A. fluviatilis* were outstanding.

This station also helped to train several more malariologists by the VCRC.

The project on Malayan filariasis control in Shertallai, also started in 1985, was initially a Technology Mission Project under the planning commission of India from which the VCRC withdrew later, a move fully supported by the then DG, Prof. Paintal. This was due to a lack of understanding of the problem by one of the influential but ignorant bureaucrats who evaluated the progress. Malayan filariasis was caused by a nematode, *Brugia malayi*, and is transmitted by *Mansonia* mosquitoes, which breed in association aquatic vegetation, mainly *Pistia* sp. The terrain is sandy, being near the coast, and only coconut trees are extensively grown in the area. There are innumerable pits which get filled with rain water and which is the main source of water for the plantation. All these pits supported luscious growth of *Pistia*. The siphons of the larvae of vector mosquitoes are attached to the root and stem of the vegetation for their breathing. If the vegetation is removed, the mosquitoes can't survive. Thus, the main strategy adopted was how to regularly get the vegetation removed, by the people themselves. They use the vegetation as manure. A profitable alternative was provided. During the five years, Dr Sabesan and his colleagues demonstrated total interruption in transmission, by combining vector control through people's participation with chemotherapy. This was achieved with community participation based on a people's movement named FILCO (Filariasis Control Movement) which took over the day to day operations. It was demonstrated that early stages of elephantiasis could be cured. The National Board for Agriculture and Rural

Development (NABARD) was also involved in the program and they helped the villagers to find alternative source of manure for their coconut trees and the giant *Gourami* was extensively grown in the pits where the *Pistia* plants were once grown. Massive rallies were organized (similar to the political rallies held these days) propagating community health through community participation. The incentives given was free treatment including treating chronic cases. The results were perceptible after five years when the transmission chain was broken and no new microfilaria positive cases were recorded in the children below five years of age. The work was published, and universally acknowledged.

The Centre had demonstrated different models for vector control. In Pondicherry, the entire operation was carried out by the VCRC. In Rameswaram, the VCRC controlled malaria with the assistance of the State Government and the success was also repeated with control of urban malaria in Salem and riverine malaria in Sathanur. In coastal malaria control programmes in Pudukkuppam and in Brugia malayi transmitted Filariasis in Shertallai, it was done with community participation and the people shared additional economic benefits. Following these success stories, the VCRC prepared MASTER PLANS for vector control in Bangalore City, Visakhapatnam, Neyveli Township and Cochin City. But unfortunately, plans were never implemented in any of these places, under one pretext or another. In my opinion there was no political will to implement the plans, which more dependence of environmental methods. The insecticide lobby was too strong.

In the early eighties, The Center sought and obtained affiliation from both Madras University and Pondicherry University. To fulfill the manpower needs of the country, the VCRC started a two-year M.Sc. Medical Entomology course in the early eighties, with an intake of 12 students per year. The syllabus was carefully drawn up to suit the needs of both research and control of vector borne diseases. Initially sponsored by the WHO, later on it was taken over by the ICMR. The WHO and some other foreign Governments sponsored students from abroad. The Centre was also recognized for the award of Ph.D. degrees in Epidemiology, Medical Entomology, chemistry, Microbiology and biostatistics. The faculty included invited guest lecturers and specialist from India and abroad, in addition to the scientists of VCRC. Till 1990, the VCRC turned out more than hundred M.Sc. and Ph.D.'s. Apart from these, there were many training programs in vector control, Medical Entomology, Microbiology, Chemistry, etc which attracted many people from outside VCRC and rest of India, and from many universities and organizations including WHO. The WHO had recognized the VCRC as its collaborating Center for Integrated methods of Vector Control, in the early eighties.

In conclusion, I would like to state that the duration of my engagement (from 1975 to 1990) was an era of challenges, and entrusted with the responsibility of building up a world class Research Institute. I was helped greatly by the then directors general, Dr. Gopalan, Prof. Ramalingaswamy, and Prof. A.S. Paintal, whom I rate as three of the most distinguished Directors-General of ICMR, and under whom I had the privilege of working as Director of the VCRC. They

never said no to any good suggestions and adequate powers and finances were given. The deep devotion and dedication to the cause of VCRC on the part of many of my junior scientific colleagues, and the support given by technical and administrative staff, etc., --all these made it possible for VCRC to become a world class research Institution. Dr Paintal, the last of the Director General under whom I had worked, called the VCRC as the pride of ICMR! I am quoting below what two of the great Scientists, both Directors General of ICMR, wrote to me, and I quote:

“The VCRC is one of the most remarkable institutions that has developed under your inspiration, an ability to link up the science of entomology with environment, with life styles of people with public health engineering.... I wish to pay a tribute to you and to your colleagues for your dedicated work” wrote Prof. Ramalingaswamy on the eve of his retirement on 23 January 1986.

The second one was written by Prof. A.S. Paintal on 29 Oct 1990, on the eve of my retirement on 31 October 1990, and I quote,

“The time has now come to say thank you for your services to the council and the cause of science for over three decades. A person of your temperament can not retire from active work-nor will it be so in your case. It was your own choice that you are retiring) instead of continuing in the Council’s service for some more time as we wished. During your tenure at NIV, Pune, GCMU Delhi and at VCRC Pondicherry, you have undoubtedly left a mark of excellence in the scientific activities you undertook, more so during the decade you have headed the VCRC, and brought it up from its small stature to the present giant

status recognized both in the national and international spheres. You have clearly established and demonstrated what can be achieved with limited resources, given proper initiative, drive and leadership”.

Both these letters were unsolicited.

While working as Director at the VCRC, I became a member of the Scientific and Technical Advisory Committee; later a member of WHO Expert committee on Malaria, Filariasis; member of the steering committee on Filariasis, and on Biological Control of Vectors. I was also WHO consultant in Indonesia, Vietnam and Sri Lanka. During this association I acquired a fair idea of how the WHO works. But I came across many Scientists –and the friendship with these scientists I still cherish. Notable among them was Dr Mani Pillai, a well-known Professor of Microbiology at the University of Otago in New Zealand. We shared our love for scientific truth and love for Indian Science.

I retired from service on 31 October 1990, after serving the ICMR (Virus Research Centre, 1953-1970, the WHO-ICMR research unit on Genetic Control of Mosquitoes, 1970-1975, and finally the VCRC, 1975-1990) for 38 years. It was a life time career full of learning, opportunities and challenges and I had enjoyed every year of my work for the ICMR. Since retirement, I had served for nearly a quarter of a century as member of many scientific committees, including my tenure as member of the Scientific Advisory Committee of the VCRC for nearly a quarter of a century, where I had received only goodwill and affection from the Director and Scientists.

I have tried to recall my impressions of my scientific career for 38 long years (in service with ICMR) and twenty years thereafter. Starting my career in 1952, the doyen of Indian Scientists and founder Director General of ICMR, Dr C.G. Pandit, recruited me when I was just a boy of 23. I had engaged myself in the cause of science for about 60 Years now. I have the full satisfaction having served under no fewer than three of ICMR's greatest Directors General. The only other DG, who joined ICMR long after I had retired, a very knowledgeable scientist, was Prof N.K. Ganguly. I admired him for his erudition and the way he listened to people. He was attentive to the problems of the institutes, and one could have a scientific discussion with him on any subject. I am proud to say that he had high regards for me.

When I retired, I left behind a research institution, with highly qualified and competent world class scientists to run it, and with all infrastructures fully developed. I feel proud that I accomplished a lot. I was honored with many titles and medals –The Om Prakash Bhasin Award (the sponsors said this was the Indian equivalent to the Nobel Prize), The Charles University, Prague, Gold medal for outstanding Research, and the coveted **PADMA SHRI** award from Government of India, all during my stay in Pondicherry. I have received three **Life Time Achievement Awards**, from (1) Association of Medical Microbiologists of India, (2) National Congress of Parasitology and (3) Anna University Department of Biotechnology. I am still engaged in occasional teaching (at SRM University, Chennai), and do write a lot on science, religion and sociology (thanks to the computer help), all for

pleasure and to keep my brain active. At a Global Public Health Conference held in February 2014, by the School of Public Health at SRM University (India's largest private University of excellence) I was one of the five scientists honoured for their contribution to Public Health.

KAS: Your thoughts on modern Vector Control Measures

PKR: The epidemiology of the disease indicates that vector control resorted to now a days after the start of the epidemic is only a public relations measure by health departments, and is totally useless. Whether you sprayed insecticides at this time or not, the epidemic was already declining. What is required is how to predict an epidemic and take vector control measures, at the start of the epidemic and prevent transmission. This requires long term studies on the ecology of the vector population and then study population build up so that an epidemic can be prevented. As it is, very little money (in terms of percentage of GDP) is allotted for research in India, and for Biomedical Research only a pittance. Whenever some serious epidemics (e.g. Japanese encephalitis) occur in India and questions raised in parliament the Government immediately allots money. What about known methods of control which are ignored. What are the practical methods to save lives? Unless you suggest some high-sounding costly research, no suggestions are accepted. But epidemics like JE continue to occur, and no one cares to find out why such epidemics recur in many areas with regular frequency. For JE we still do not have an effective single dose vaccine; and even if you have one, what is the target population and in which area, will you vaccinate? When I wrote a paper detailing the epidemiology,

and sent it to the authorities giving examples of practical methods of JE control – the “higher ups” cynically laughed it off saying it is SPICY. But one of the highly respected and well-known fortnightly journal FRONTLINE, with a large circulation, published it with the title “Combating the Killer and which had rave reviews. The authorities seem to be saying “*Our minds are made up; do not confuse us with Facts*”! I have always wondered what the aim of research is. The aim should be to find out new approaches which would be helpful to improve our understanding of the epidemiology and control of the disease.

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