
A DIALOGUE WITH DR. ANANTANARAYANAN RAMAN

A VISIONARY ECOLOGICAL
ENTOMOLOGIST WITH AN
INTERNATIONALLY RECOGNIZED
EXPERTISE IN THE FIELD OF INSECT
AND PLANT INTERACTIONS.



It is a proud privilege and an honour to interview a visionary Entomologist Anantanarayanan Raman, who has specialized on gall-inducing arthropods and who works on the mechanisms from both insect and host-plant perspectives, interlinking the ecology and physiology of the interacting organisms. He holds two doctoral degrees and has extensive undergraduate and postgraduate teaching experience in Agricultural Ecology, Forestry, Ecological Entomology, Agricultural and Forest Entomology, Plant Pathology and Nematology. He has been investigating issues related to sustainability and sustainable-land management over last 25 years. He is an internationally recognized expert in the field of insect and plant interactions and the winner of the prestigious Fulbright Award in 1990 and the Deutscher Akademischer Austausch Dienst [DAAD] Award — twice — in 1991 and 2003. He has, to his credit more than 300 research publications documented in international journals, further to a dozen books and monographs. His work and publications demonstrate his independent research capabilities, further to a strong capability to organize and administer teaching and research projects, and critically analyze their outcomes. He has a strong commitment to the development of higher education and pedagogical processes with advanced

written and oral communication skills. With all these, he is an effective teacher and a motivated researcher with accomplished leadership, problem solving, and group facilitation skills, which are well supported by an extensive international work experience.

Brief bio-data

He was born to Sri K. P. Anantanarayanan and Srimathi R. Parvathy in Madras (now Chennai), Tamil Nadu. He completed his high-school education from Sir M. Ct. Muthiah Chettiar Boys' High School (now a Higher-Secondary School), Purasawalkam, Chennai. He completed his B. Sc. Degree from Loyola College, Chennai. Later he completed his master's from Presidency College, Chennai.

Soon after post-graduation, he was appointed as a Lecturer at Loyola College and in 1972, joined Dr. T. N. Anantakrishnan's research group. Inspired by Dr. Anantakrishnan, he took up studies on gall-inducing insects and started his PhD on the physiology of galls induced by Phlaeothripidae (Thysanoptera) and the ecology of the inducing Phlaeothripidae, which included the extraction of salivary glands of the inducing thrips taxa and their biochemistry for enzymes. He ,

travelled to Université Louis Pasteur, Strasbourg, France, to work with Odette Rohfritsch at the *Laboratoire de Cécidologie* (LdC), directed by pioneer Cecidologist Jean Meyer. During his several months stay in Strasbourg, he had occasion to be associated and work with other leaders of gall studies, Evelyn Westphal, Roberte Bronner, Françoise Dréger, who were scientists at the LdC. He earned his first doctorate in 1981.

He married Lata née Vaideswaran in 1983. He continued to work with Dr. T. N. Anantakrishnan. In 1990, he was awarded the Fulbright Fellowship by the Fulbright Commission, c/- The Bureau of Educational & Cultural Affairs, U. S. Department of State, Washington, D. C. He was associated with Warren Gene Abrahamson, Burpee Professor of Plant Genetics, Bucknell University, Lewisburg, Pennsylvania and worked on the energetics and nutrient mobilization in gall systems, using *Rhopalomyia solidaginis* (Diptera: Cecidomyiidae)–*Solidago altissima* (Asteraceae). Soon after, he moved to the Universität Heidelberg, Germany winning a *Deutscher Akademischer Austausch Dienst* (DAAD) Fellowship and worked with Rolf Beiderbeck on dual-aseptic culture of insects and their host plants, testing the model system *Trialeurodes vaporariorum* (Hemiptera: Aleyrodidae) and its host plant *Stellaria media* (Caryophyllaceae). He standardized the protocol for the dual culture of a *T. vaporariorum* and cultured shoots of *S. media*. The protocol published in the *Zeitschrift für Angewandte Entomologie* (= *Journal of Applied Entomology*) is popularly referred in literature as the Raman–Beiderbeck protocol.

In 1996, he moved to Australia to join the University of Sydney, Orange campus, New South Wales. Notable that this campus changed to Charles Sturt University in 2006. During this tenure, he worked on the tortricid *Epiblema* and a curculionid

Conotrehalus infesting *Parthenium* in association with Kunjithapadam Dhileepan, Queensland Department of Primary Industries, Brisbane. His average academic productivity in terms of quality-journal publications was from 13 to 18 papers/year.

He submitted his 2-volume thesis staking the claim for the title of Doctor of Sciences of the University Madras and got the title in 2003. During his tenure as a Senior Academic at Charles Sturt University, Orange, he supervised 18 Ph. D students, 12 research-Honours students, and 1 MPhil student. In 2020, he joined CSIRO, Perth, Western Australia as a Senior Scientist.

He has won several research grants and recognitions. He was the recipient of the Agricultural Innovation Research Excellence Award given away by Charles Sturt University & Graham Centre for Agricultural Innovation in 2016. Earlier for three years in succession he won the Faculty of Science Research Excellence Award also by the Charles Sturt University. He was awarded the Australian Academy of Science Visiting Professorship in 2008 to visit a few universities in Japan and Taiwan. The Entomology Academy of India honoured Raman with the M S Mani Centenary Award in recognition of the multiple contributions to Indian Cecidology. Crowning all of these, he was recognized by the Indian National Science Academy, New Delhi, as the Vulimiri Ramalingaswamy Chair in 2018, upon the nomination by Raghavendra Gadagkar and Raman Sukumar of the Indian Institute of Science, Bangalore. During this travel, he lectured and conducted workshops at the Centre for Ecological Sciences, Bangalore, delivered lectures at Tamil Nadu Agricultural University, Coimbatore, Manonmaniyam Sundaranar University, Tirunelveli, Manipur Central University, Imphal, Indian Agricultural Research Institute, New Delhi,

and Indira Gandhi National Open University, New Delhi.

**Interview of Anantanarayanan Raman (AR) by
Dr. Kolla Sreedevi (KS)**

KS: Is the study of insects a choice or chance?

AR: Definitely by chance. During my undergraduate days at Loyola College, Madras, I had known of Ananthakrishnan, who was then heading the department of zoology; but my acquaintance with him at that time was casual; the silver lining was that I had chances to meet him often. However after my post-graduation when I joined Loyola College as an academic, our relationship got strengthened. I used to spend more time with him at the Entomology Research Unit, which he directed.

KS: Can I know the inspiring or guiding force behind choosing Entomology?

AR: Ananthakrishnan was a key force. He was a towering personality by his seriousness of purpose and academic productivity. He was the singular recognized specialist of the Thysanoptera throughout the world then. Like any other academic of those days, he spoke English eloquently and charismatically. His oratory power and the high-quality English he wrote was one strong factor that attracted me to him; entomology was --- then --- secondary. He presented himself most elegantly and gracefully, appearing far younger than his real age. All of these, and the power of science brought us close to each other. Moreover during my post-graduate days at the Presidency College, Madras, I was fortunate to have a great Indian biologist, B G L Swamy, as professor and his classes were a deep source of inspiration. He did not teach like everyone. He inspired me by flinging challenges both within the class and outside. That practice stimulated me to think outside the box and

importantly unconventionally. This intellectual background of challenging the raw and the apparent must have fostered and cemented the relationship between me and Ananthakrishnan. But I am not sure whether this is correct. Anyhow circumstances came around and I was naturally sucked into exploring the world of insects, starting with the Thysanoptera.

KS: How did the study of gall-inducing insects become your favourite?

AR: While being a post-graduate student at Presidency College, one of my lecturers was K V Krishnamurthy, who spoke to me about insect-induced galls and suggested that we look into their biology. As an MSc student, I helped him out working out the leaf galls on an epiphyte *Aeschynanthus perrottetii* (Lamiales: Gesneriaceae) induced by *Prolasioptera aeschynanthus-perrottetii* (Diptera: Cecidomyiidae). During this investigation, I carried several draft manuscripts for reading, editing, and commenting by Ananthakrishnan in Loyola College. This experience also brought me closer to Ananthakrishnan. This first co-operative work with Krishnamurthy resulted in a journal paper published by a then highly prestigious journal dedicated to study of insect galls and their agents, viz., *Marcellia*, edited and published by Jean Meyer at the Laboratoire de Cécidologie, Université Louis Pasteur, Strasbourg, France. Publication of this paper in *Marcellia* enabled me to know many who were working on galls outside India, the world of galls, and started reveling in those biological marvels. I co-operated with Krishnamurthy and derived some support and guidance from Ananthakrishnan after I joined Loyola College as a lecturer. Krishnamurthy, Ananthakrishnan, and I jointly published papers on galls induced by diverse arthropods, such as, *Aneurothrips priesneri*

(Thysanoptera: Terebrantia), *Baris cordiae* (Coleoptera: Curculionidae), and *Aceria cordiae* (Acari: Eriophyidae) hosted by *Cordia obliqua* (Boraginaceae). This study was published in the *Ceylon Journal of Science*. At this time, I came under the influence of B Vasantharaj David, research officer with Ananthkrishnan. David introduced me to the Aleyrodidae; David and I jointly published the biological details of *Indoalcyodes pustulatus* (Hemiptera: Aleyrodidae) that induces pit galls on the leaves of *Morinda tinctoria* (Rubiaceae) in *Cecidologia Indica* published by Prabha Grover, a Cecidomyiidae specialist of India then, of the University of Allahabad. Once these works were published, I enthusiastically dug my claws deeper into this subject, since this field panned out to me a dynamic discipline of insect—plant interactions, a widely sought-after theme in the 1980s. Moreover I got introduced to paper publishing. Seeing my name in print became an addiction.

KS: *Have you faced any challenges in studying gall-inducing insects or the mechanisms involved in gall induction.*

AR: Not one; several. During my early days of study not much about galls was known. As I was starting to work on my PhD thesis pertaining to the nutritional physiology of select-species of gall-inducing Phlaeothripidae (Thysanoptera), I needed to learn how the mouth-parts of the miniscule thrips were organized and to dissect the salivary glands aiming to analyze the salivary proteins. I struggled. This was a major, nerve-wrecking challenge. However, I mastered the craft of teasing out the salivary glands in the next few weeks. During field trips determining the identity of the gall-hosting plants was another challenge. Ananthkrishnan would determine the inducing thrips. But knowing the binomial of the plant was a Himalayan task:

invariably when I went to the field, I got only galls with plants bearing no reproductive structures: neither fruits nor flowers. I learnt how to ascertain plant identities using only vegetative characters, similar to the practices followed by foresters. Since Loyola College was essentially an undergraduate college, the kind of facilities and equipment I had at my disposal were minimal. I worked with student microscopes. Facilities to carry out physiological work was unthinkable. I had to resort to using elementary paper-chromatography to separate salivary proteins. In the next decade I mastered techniques of histochemistry to qualitatively characterize functional components of both host-plant and insect tissues. What satisfies me most today is that I could interpret my findings and publish them in recognized professional journals in spite of the hiccups and handicaps I experienced.

KS: *Can you please elaborate on the significant Raman–Beiderbeck technique for the benefit of readers. Is it related to gall-inducing insects?*

AR: First I should clarify that what is generically referred as the Raman–Beiderbeck technique in reality does not pertain to gall-inducing insects and their physiology. Plant-tissue culture was popular in the 1980s and some insect tissue culture was also known. Rolf Beiderbeck of the Universität Heidelberg was a trained plant-tissue and protoplast culturist and he was trialing dual aseptic culture that involved culturing plant tissues and raising the infesting arthropods simultaneously on those aseptically grown plant tissues, which was known as dual-aseptic culture. I was impressed by this and sought training with Beiderbeck in 1991. I used *Stellaria media* (Caryophyllaceae) as the host tissue for aseptically growing populations of *Trialeurodes vaporariorum* (Hemiptera: Aleyrodidae). The main challenge that involved weeks and weeks of trials was to apply the right percentage concentration

of sodium hypochlorite to surface sterilize the eggs before placing them on the cultured *S. media* tissue in defined enriched agar medium. Defining the right concentration of the NaOCl solution — the surface sterilant — so that the embryo is not killed because of micropyles was a major challenge. However I succeeded and it eventuated as a protocol paper published in *Zeitschrift für Angewandte Entomologie* (today the *Journal of Applied Entomology*). Micro details of this protocol can be extracted from: Raman, A. and Beiderbeck, R., 1992, Aseptic dual culture of the greenhouse-whitefly *Trialeurodes vaporariorum* Westwood (Hom., Aleyrodidae) and its host *Stellaria media* (L.) Vill. (Caryophyllaceae), *Zeitschrift für Angewandte Entomologie*, **113**: 252–257. Although I did not use a gall-inducing insect in this work, I am aware that many trials involving gall-inducing arthropods have been used by several persons across the world. This protocol has been handy in clarifying the functional aspects of gall-inducing insect and its plant relations.

KS: *It's fascinating to hear that you have continued your research work on gall-inducing insects throughout, what made you continue or keep going in the same field.*

AR: Thank you for your generous words. When I started work on gall-inducing insects (*sensu lato*, to include species of Eriophyidae (Acarina) as well), my first understanding was that this is an interactive system that intimately involves a plant on the one hand and an arthropod (an insect, mostly) on the other. Therefore I told myself that I needed to be acquainted with every detail of the arthropod I was working on and I needed to possess the same acquaintance with the host plant. An absolute clarity of this understanding made me appreciate the dynamics of their interactions: how the insect exploits the plant and how the plant responds to

insect action — producing an enchantingly symmetrical structure, *i.e.*, the gall, and eventually restrains the stress inflicted by the inducing insect. Importantly the gall is an restraining outcome. The alterations induced by the insect action are elegantly restricted to the gall site only. Nothing transcends further, unlike the tumours induced by the Rhizobiales (e.g., *Agrobacterium tumefaciens*). In the Rhizobiales-induced tumours, secondary tumours arise with no *A. tumefaciens* in them. A tumour-principle is transmitted through the plant and secondary tumours eventuate. In arthropod-induced galls nothing of that sort occurs and will ever occur. Gall will materialize where a larva (e.g., Cecidomyiidae) or a population (e.g., Phlaeothripidae, Adelgidae) will infest. With this clarity I approached insect-gall systems, first using the Phlaeothripidae-induced galls and later with species of the Psylloidea. For a better understanding of galls, I looked into galls induced by the Beesoniidae (Hemiptera: Coccoidea), Eulophidae (Hymenoptera), Curculionidae (Coleoptera), and Tortricidae (Lepidoptera). But works on these insects were not consistent. My consistent work pertained to my exploration of developmental physiology of galls induced by the Phlaeothripidae and the nutritional physiology of the corresponding Phlaeothripidae, when I commenced serious work. From 1985 I shifted to studying the gall-inducing Psylloidea and their galls that were plentifully available in the vicinity of Madras. I worked out the biology and bionomics of an unusual gall-inducing Psylloidea *Phacopteron lentiginosum* (host plant *Garuga pinnata*, Burseraceae) and published my results in the journal *Phytophaga* in the 1990s. Based on my work on the biology and bionomics and unusual oviposition behaviour of *P. lentiginosum*, Daniel Burckhardt (Basle, Switzerland), a world-Psylloidea authority, moved this taxon from the Pauropsyllidae as indicated by

Ram Nath Mathur of Forest Research Institute, Dehra Dun to a newly erected uni-generic Phacopterinae.

Every time I completed a work and got a publication ready, I had new questions. Seeking answers to those questions kept me fully engaged and I have felt that a lot more needs to be done in this discipline. What was vital was clarity of thinking and intent of purpose.

I need to clarify here that I have published extensively on the chemical ecology of *Heteronychus arator* (Coleoptera: Scarabaeidae) and biophytic (non-pathogenic) endophytic fungus *Neotyphodium lolii* (Hypocreales: Clavicipitaceae) included in *Lolium perenne* (Poaceae). Once some clarity of these interactions was achieved, then I explored the effect of heterotrophic (pathogenic) fungus *Botrytis cinerea* (Helotiales: Sclerotiniaceae) infecting *Vitis vinifera* (Vitaceae) and *Epiphyas postvittana* (e.g., *Entomologia Experimentalis et Applicata*, **160**, 47–56). In addition my research group has published extensively on the eco-restoration of contaminated land sites (e.g., high level metal-contaminated mine sites and salinity-afflicted crop lands) using phytoremediation techniques. The novelty in this effort was that we established diverse phytoremediation possibilities employing plants native to eastern Australia.

KS: *Having expertise in teaching and research, which one you enjoyed the most.*

AR: Undeniably and undoubtedly I enjoy being a teacher. But my conviction is that to be an effective and contemporary teacher, I need to be an active research person. Research enabled me to keep abreast of scientific and technological developments that enabled me to perform as a better teacher. Importantly, research empowered me

with a deep sense of curiosity to know more. That curiosity was a powerful tool useful in my classroom and field teachings.

KS: *May I know the turning point in your career?*

AR: I cannot think of anything as a critical turning point. But my permanent migration to Australia leaving my homeland was painful. Taking up an academic position with the University of Sydney required me to change many aspects of my professional life. I had to re-train myself in the new ambience I was situated in circumstances beyond my control. Teaching style had to be different because of cultural differences. But the better element was that I could quickly adapt and respond to new needs, thanks to my earlier overseas stints and experiences. Perhaps this can be considered a turning point in my life. New demands, new practices dealing with the new environment. I had to re-invent myself.

KS: *In your opinion, what makes an inspiring teacher?*

AR: What makes an inspiring teacher? In my thinking one who is able to touch and connect with the hearts of learners while transmitting the information is an inspiring teacher. Learners always remember such a person with passion and a shade of gratitude.

KS: *Having worked in India and abroad, can you please throw light on suggestions for the quality research?*

AR: In my opinion, honesty and academic integrity are the keys to quality research. Even if we are only able to turn around only ordinary research outcomes (means not necessarily cutting-edge research, trail-blazing research, sexy research) as long as those outcomes are steeped in honesty and integrity then I would consider that quality research. I am highly

depressed to read news items that speak of paper retractions by editors of high-class journals on a regular basis based on reasons of plagiarism, lack of academic honesty and integrity. This makes me think whether we have lost our values precluded by and shadowed by the rush for development and technology. Depressing and nauseating.

KS: *Can we know the overseas opportunities in Entomology field*

AR: Opportunities are aplenty. But it requires constant vigil and serious search. Opportunities are wide and open. However, Indian university training in Entomology and other biological disciplines still follow an examination-oriented training programme (please see my article entitled, 'What is a curriculum, what is its purpose: reflexions on an entomology curriculum for India', *Indian Journal of Entomology*, 2017, **79**, 121–122). This is not desirable. Western universities train their learners (in all disciplines, including entomology) by challenging them and triggering them to seek and learn by themselves. Curriculum cannot be misconstrued for syllabus; it is not simply words and dashes. Curriculum is a complex term that has multiple dimensions and multiple components. University-level learners need to be enabled, empowered, and equipped to seek knowledge by themselves and build problem-solving capability. When this is attained, we will be better practitioners anywhere: within and without. When learners are empowered to seek knowledge by themselves, they will automatically build confidence in the self; a self-confident, yet humble person will be automatically sought by employers in India and elsewhere --- quite naturally.

KS: *It's wonderful to know that you have about 100 papers on the history of Madras (Now Chennai), how it's possible to balance the interest in different disciplines (lines/areas)*

AR: Elementary, Watson (with apologies to Arthur Conan Doyle: creator of Sherlock Holmes)! Science bores and frustrates me many a time. At those dull moments, reading about and exploring my home town --- Madras, and not Chennai ---- by stretching and applying my scientific thinking and training, I feel rejuvenated. That gives me significant respite from the rigmarole of science. I am able to think as an artist and act as a humanist. Every aspect I explore about the city and state of Madras gives me ample opportunities to appreciate and re-live in the past, which appears glorious to me. In my eyes, buildings and other structures rise and fall, dynasties evolve and degenerate, humans come and go. For example, I have chronicled the lives and works of many medical doctors who had served --- some biased and some unbiased --- humans in Madras city and presidency in diverse ways. In that process they have, or rather should have, enabled longevity and better health by curing peoples' illnesses and chronic diseases. Ironically those medical personnel had died someday that divulges to me: *c'est la vie*. Life is full of education. I learn modesty and humility from writing about the history of Madras, which I see as a matter of reprieve from the occasionally frustrating and boring science including entomology.

KS: *Can you narrate your hobbies or interests other than science*

AR: I am not sure whether I have any practice that can be listed as a hobby. I have a few alternative interests, such as the one explained above. Other than that I am interested in learning and knowing about India's rich culture, history, and heritage. Proudly I share my thoughts on these aspects when asked to share. Some of my close friends discuss matters relating to these topics with me and I joyfully participate in those conversations. I share what I know and importantly I stand to gain from

those conversations. I am deeply interested in the Dravidian stock of Indian languages. I am an ardent fan of Badriraju Krishnamurti (former Vice-Chancellor of Hyderabad Central University), an eloquent authority on Dravidian languages and I speak of his messages on the relationships and individualities of Tamil, Kannada, Telugu, Malayalam, and most importantly Tulu, a minor Dravidian language spoken in pockets of *Dakshina Kannada* and Northern Kerala.

KS: *Your advice and suggestions to the young generation.*

AR: I am nobody to advice anyone else. But I am a firm believer in truthfulness, honesty, and academic integrity. I am a strong believer that the underpinning element of research in any discipline is sincerity and not greed to win positions, accolades, and awards. These are my personal values. I would not say these publicly to anyone. I am sure every individual can and will take care of him-/herself.

Concluding remarks by KS:

It was a great pleasure and privilege interviewing Dr. Raman and was a great learning experience hearing to his rich experience and expertise. Dr. Raman is an accomplished teacher and a dedicated researcher. I was very much impressed by his perseverance, objectivity, critical thinking and time management. His career journey speaks of his

commitment, determination, dedication and devotion. It was a sheer delight and honour interviewing Dr. Raman, which was an edifying conversation. I am sure that this interview and journey of Dr. Raman's scientific approach in understanding and deciphering the mechanisms of gall induction by insects will benefit the readers at large and inspire students and young scientists in particular to pursue their career in gall inducing insects, which is a key area to work upon.



Dr. Kolla Sridevi conducting interview of Dr. A Raman

Dr. Kolla Sreedevi is an ICAR National Fellow and Principal Scientist heading Scarabaeid lab in Division of Germplasm Collection and Characterisation, ICAR-NBAIR, Bengaluru. She has got more than 15 years of experience in taxonomy of beetles.

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