Aries Kovoor: A vision for science

by Senake Bandaranayake

Aries Kovoor was born in 1927 in the historic city of Kottayam, in the Kingdom of Travancore., now part of the modern Indian state of Kerala. At the age of three he came to Sri Lanka with his parents. His father was the famous rationalist Abraham T Kovoor, who settled here in the 1930s.

The young Kovoor went to school in Jaffna and, at the precocious age of 15, to the University of Madras in Chennai, as the University of Ceylon had a minimum entrance age limit of 18. He graduated in 1945. After post-graduate research in Madras and a short spell of teaching in Sri Lanka, he began his scientific career in earnest with the Indian nuclear physicist Homi Bhabha at the very inception of the Tata Institute for Fundamental Research (TIFR) in the late 1940s.

In 1952, eager to specialise in the emerging field of the new biology, Kovoor joined Roger Gautheret's CNRS (*Centre National de la Recherche Scientifique)* laboratory in Paris where he worked for nearly forty years. Gautheret was one of the pioneers of the new biology and can be described as 'the inventor of plant tissue culture'. Thus, at the very beginning of his career, Kovoor's scientific vision was forged in the company of scientists such as Bhabha and Gautheret.

Despite his work in the CNRS Kovoor also returned periodically to Sri Lanka as an active scientist from the 1970s and worked here on a regular basis since 1985, till his death in 2006.

My acquaintance with Aries Kovoor goes back to my schooldays in Mt Lavinia, where his father was my science teacher. But my friendship with him really began when we met again in Paris in the 1960s. The encounter immediately plunged me into an environment richly immersed in the history of science. His laboratory was in the Place Jussieu (named after a family of 18th century French botanists), overlooking the Rue Cuvier (named after that pioneer of palaeontology and animal taxonomy). The Rue Cuvier marked one of the boundaries of the Jardin des Plantes, which since the 17th century had been the principal theatre of French research in the plant and animal sciences. Next door to Kovoor was the historic laboratory of Marie and Pierre Curie and the Joliot-Curies.

Kovoor's work in the 1950s and 1960s is best seen from his record of publications and meetings. It shows that he was one of a very small number of Sri Lankans working in a field on the frontiers of science, in his case the field of cell and molecular biology, the term 'molecular biology' itself coined only in 1939. By the 1960s his work already displayed those qualities that were conspicuous in later years: the unmitigated dedication to the intellectual satisfactions of pure science combined with the essential requirement of working on the bench and in the field; a view of the larger picture but a meticulous application to detail; social concerns that led him to investigate the potential that fundamental research held out to the day-to-day world; an abiding concern with the exponential transformation molecular biology could bring about in the human search for food and medicine; the formulation of several *grands projets* that led to the shaping of a complex and profound vision that encompassed all this.

Kovoor was 25 when he entered Gautheret's laboratory in 1952 and worked there until 1969. With the reorganisation of French universities he became the head of the *Laboratoire de Physiologie de la Différenciation Cellulaire Végétale* of the University of Paris VII, a position he held till his retirement in 1992. The essential nature of his vision and the intellectual environment he was nurtured in are well expressed in his own words, as Shantha Ramanayake quoted in her most beautifully written notice on Kovoor soon after his death, in the *Journal of the National Science Foundation*):

"The liberty of research prevalent in a university environment certainly tempts a scientist to cut across the barriers of orthodox disciplines and techniques in a somewhat carefree manner. It is because the pure scientist's approach is solely dictated by a child-like curiosity, a highly subjective train of ideas and the feasibility of experimentation. Preconceived notions defining the limits of a given domain and the motive of application for economic benefit are notably rare.

"The advent of plant tissue culture provided no exception to this pattern. All of its aspects which we now regard as of capital importance for agriculture were nothing but botanical curiosities at the time of their inception. The aimless proliferation of callus tissue, unpredictable organogenesis *in vitro*, protoplasts resulting from cell damage, plant galls, embryo-like formations among cells and tissues, and in a freakish manner even from pollen…. None of the pioneers could honestly claim to have foreseen the multiple repercussions of what was only a fairly simple technical innovation. My own experience, like that of most others acquainted with the technique from early days, led me to stray into a variety of paths with alarming facility." (Kovoor 1992).

During the 1970s, Kovoor worked on the induction of plant tumours by the introduction of foreign DNA, and its consequences for genetic manipulation. He was interested in recombinant DNA technology, the study of DNA sequences in higher plants and DNA synthesis; the detection of DNA modifying enzymes and the replication of mitochondrial DNA during organogenesis in tissue cultures. The study of plastid DNA polymorphisms led to the formulation of what is known as the Hussein-Kovoor Index which permitted the measurement of phylogenetic distance between different species. Behind this record of fundamental research there always lurked an abiding interest in the world around him and the implications of such insights and techniques at a molecular and cellular level for the development of tropical agriculture. It was in this conjuncture of science and social concern that his evolving vision for science was formed.

Some of my first encounters with Kovoor's scientific vision came in long evenings we spent in Paris where we enjoyed passionate discourse, good food and the irreplaceable Parisian cultural style. These were also the heady days of the Vietnam War, the Cultural Revolution in China, Paris '68, the philosophy of Mao Zedong and Louis Althusser, the bravura of Che Guevara. Kovoor was greatly excited by his own work in Cuba, where he was engaged in setting up a unit for teaching and research in Plant Biology and Physiology in the University of Havana.

Talking of Cuba inevitably led to the discussion of the extraordinary biotic wealth of the tropical world, of the great potential of tropical agriculture, and the important role Sri Lankan science could play. Cuba was the starting point of his scientific involvement with applied tropical agriculture. He talked at length about tree crops and timbers and this discussion had a special place in it for palms. He was very pleased with his membership of the International Palm Society and also of the French association of 'palm fanatics', *Le Fous de Palmiers*. Much later in his career he authored an FAO Paper on palm tissue culture and its application to coconut (Kovoor 1981) and a manual for FAO on the palmyra palm (Kovoor 1983).

The most startling notion he put forward in my early meetings with him was the concept of the solid coconut, where the kernel would fill the entire cavity at the centre of the nut. Kovoor was fascinated by the mutation that created that delicacy much sought after by gourmets in southern Sri Lanka known as *dikiri pol*, and as *macapuna* in the Philippines. This was a coconut in which the kernel did not harden but remained in a thick, cavity-filling cream-like form even softer and more runnier than the soft kernel of the *tambili (Cocos nucifera* var. *aurantiaca)*. The idea that *tambili*, the golden-coloured king coconut, was a cultivar of Sri Lankan origin inspired the search for the molecular structure that lay behind *dikiri pol*, a possible pathway to the 'invention' of the solid coconut, a development that would lead to the doubling of the productivity of coconut plantations.

As a molecular biologist and someone whose moral and aesthetic value system deplored commercialisation, Kovoor understood well the positive and negative consequences of research oriented towards genetic engineering, but in later years he was impatient with the discussion regarding genetic modification. The basis of civilisation, he said, as archaeology has shown us, is the genetic modification of plants.

The 1950s, 60s and 70s were three middle decades spent mostly in France. Kovoor did not come home frequently, but through his father and his friends took an avid interest in things that were happening here. He was keen that his wife Dr. Jacqueline Kovoor, herself a scientist at the CNRS, and their three sons -- Avara, Thierry and Shankara – had a close relationship with his parents and his country. His real scientific involvement in Sri Lanka began in the 1970s when Dr. Colvin R de Silva as Plantations Minister invited him to help build the tissue culture laboratory of the Coconut Research Institute (CRI) at Lunuwila and to do in Sri Lanka, in a somewhat different way, what he had already done in Cuba. He was thereby one of the pioneers of plant tissue culture in Sri Lanka, along with his younger co-workers, Sita Karunaratne, and later Shantha Ramanayake, Manisha Rajapaksa, Shyama Fernando and many others at the CRI and the IFS in Kandy.

With his homecoming he envisioned two main programs based on his ongoing research in France and also his experience in Cuba and India. One was the ambitious coconut tissue culture program at Lunuwila, and the other, which started a little earlier, an even more ambitious Planning Ministry scheme for scientific manpower development (1973), which consisted of training on the bench, in two-year cycles, "a hundred M.Sc.'s" in plant biotechnology and molecular biology. The idea was to create a large pool of young, laboratory-based scientists whose very presence would transform the nature and pace of Sri Lankan plant science research.

These were two visionary programs but economic difficulties, institutional barriers, personality issues and policy changes prevented their immediate realization in quite the way he visualised. The CRI laboratory, however, was built by 1977 and the program made slow but sure progress over time. The manpower project was long forgotten but resurfaced in different forms years later.

The most visionary period of Kovoor's career began in the mid-1980s, when he was invited by Cyril Ponnamperuma to establish a Plant Biotechnology project in IFS. In this period, Kovoor also embarked on a series of visits to key tropical locations: palms in Costa Rica (1983), forests in Colombia and Brazil (1983), the Kakamega Forest in Kenya (1988), Assam and Meghalaya in Northeast India (1991), two extended stays in the Peruvian Amazonia (1991, 1992), and a visit to Brunei (1993).

At home in Sri Lanka, in Colombo, Kandy, Sigiriya and Dambulla a number of ideas were aired. Kovoor's Corbuserian house in Colombo had its botanical library, and a computer data base. The IFS in Kandy was a centre for visionary science. In Sigiriya Kovoor was helping us to develop a botanical garden of trees native to that particular sector of the Sri Lankan Dry Zone. At Sigiriya, too, and by extension in the high plateau of the Horton Plains, we had also launched an ambitious palaeobotanical and palaeoecological program. Not far from Sigiriya was the IFS-Popham Arboretum at Dambulla. Each of these places attracted a long line of visitors from home and abroad. Colombo evenings and long stays in Kandy and Sigiriya set the scene for extended discussions on a wide range of subjects.

One of the favourite subjects of discussion was an issue whose crucial importance is yet to be properly placed on the agenda of 21st century science and developmental thinking. I might summarise it in the following way:

"The 21st century will be a century of trees. Plant molecular biology, genetic engineering, and large scale, lab-based, bio-tech propagation, would make tree-based crops a major expansion area in world agriculture."

A corollary to this was the observation that the greater part of the tropical world, (whose biotic potential surpasses that of any other global region) consists of Dry Tropical Forests, rather than the more famous Wet Tropical rainforest regions. The Dry Tropics, a good example of which is the Dry Zone of Sri Lanka, are a major world agriculture region, with relatively high populations, home to a number of peoples and cultures, greatly dependent on increasingly scarce and unreplenishable water resources. On the other hand, the forest tree species of this region, as the IFS-Popham Arboretum demonstrates, are highly resistant to drought and are not at all dependent on irrigation. They are the time-tested natives that have forested these biotopes over millennia. If these qualities of ecological adaptation are combined with the genetic potential that tree varieties display (as, for instance, IFS research pinpointed) the agriculture of the 21st century in the Dry Tropical region could be a tree agriculture of an entirely new type. Moreover, this would be applicable in different ways to the wet rainforests and the arid scrublands and deserts.

Kovoor set about fleshing out this vision with five futuristic but not improbable programs, combining fundamental research with relatively simple practical applications, holding great scientific and social potential. These projects were:

1. the Forest Tree Bank;
2. the Tropical Trees database;
3. the micro-grafting of fruit trees and other genetic engineering processes;
4. the Giant Bamboo program;
5. the Sigiriya Archaeobotanical conservatory.

The **Tropical Forest Tree Bank** concept was based on the perception that Sri Lanka was a microcosm of the world's tropical regions; that it had within its shores and with easy access all (or almost all) the tropical biotopes that could be found around the world, from dense equatorial rain forests to the most arid scrublands and deserts. As Kovoor himself described it this "led to the idea of creating in the country a forest tree bank of all the tropical trees in the world."

"The basic constraint," he maintained, "for executing this ambitious project, was the technical know-how for *in vitro* collection and intercontinental transportation of tree germplasm." The necessary technique "had already been well mastered" in his laboratories in Paris and Kandy. An important item in this procedure was the 'Sossou flask' which Kovoor had jointly invented with one of his students and co-workers, Prof. Sossou from Benin. The Sossou flask enabled in situ collection of plant tissue and its transportation from remote locations in highly portable but sterile conditions. If governmental policy makers had seriously understood the implications of the proposal and the project had reached significant proportions Sri Lanka would have inherited a living germplasm bank of tropical trees that would constitute a unique resource for future research and development.

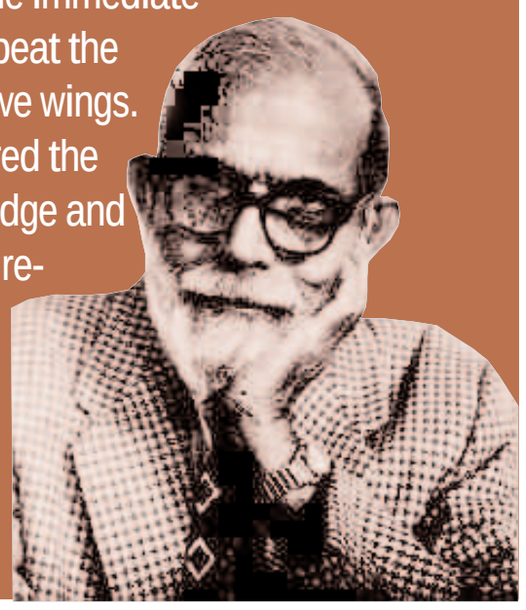
Closely connected with this Tropical Forest Tree Bank project was Kovoor's own personal **tree database**. Using software devised by his son Thierry, and his own elaborate data template, he set out to document from whatever sources he could use, the entirety of the tropical tree species and varieties in the world. This included rare and disappearing species. In his database he would indicate where such specimens could still be found. His botanical library, which was a major source of information for this project, was arranged according to his own classification and shelving system based on a country's latitudinal and longitudinal coordinates.

Kovoor's work in plant biotechnology was essentially focused on trees. Coconut and by extension other palms such as palmyra first drew his attention, and later also kitul and that very special type of palm, rattan. He was fascinated by kitul, difficult to regenerate by normal planting. With his co-workers he pioneered its *in vitro* embryo culture. As for rattan he had catalogued every known species in the world (217 in the late 1980s) and proposed the establishment of a rattan germplasm bank in Sri Lanka. Also difficult to regenerate, rattan is not cultivated and is generally gathered from forests. His team made it possible to regenerate rattan in the laboratory so that it could easily be farmed. Like most Sri Lankans a great lover of tropical fruit, he placed considerable importance on research in durian, mangosteen and cashew, especially paying attention to problems of *in vitro* propagation, using techniques such as embryo culture and micro-grafting

Kovoor's IFS laboratory experimented with devising new types of fruit combinations, especially at a cellular rather than a molecular level. They attempted to micro-graft durian with baobab and mangosteen with *Pentadesma butyracea*. In the case of cashew, which flourished in relatively dry conditions, grafting to *Anacardium microcarpum*, a wild Brazilian cashew, would make it even more resistant to drought. We joked about growing mangos on cashew trees that could be planted in arid zones, an ideal environment for high quality fruit production, and for grafting cashew onto mango trees in the wetter conditions that mango preferred. The work on fruit trees produced interesting research results as the ensuing literature shows, but as a whole everything still remained in the realm of ideas. But, as the history of science often demonstrates, ideas have wings.

One of Kovoor's most far reaching and immediately implementable programs was the Giant Bamboo project, still on the program of action, though in a much modified form. Studying the time machine built into the periodic cycle of the flowering of giant bamboo, and propelled by his co-worker Manisha Rajapaksa's discovery of a plant mutation which flowered out of cycle, Kovoor's IFS laboratory 'invented' the *in vitro* embryo culture of giant bamboo, a major breakthrough in world bamboo research. Kovoor proposed setting up a large-scale production laboratory and nursery and a

Kovoor's scientific life had spanned the latter half of the 20th century and his work and vision were on the frontiers of science in his time. Even if his far-seeing proposals produce no lasting and tangible results in the immediate context, one may repeat the saying that ideas have wings. His ideas have entered the great river of knowledge and will re-surface or be re-invented by the scientists of the future. Kovoor will be recognized as a visionary pioneer.



Aries Kovoor Memorial Symposium: "Innovations in Plant Sciences through Multidisciplinary Science", will be held on 3rd March 2008 at the Institute of Fundamental Studies, Hantana Road, Kandy. This Symposium is organized and sponsored by the Institute of Fundamental Studies, National Research Council and the National Science Foundation of Sri Lanka, to honour late Prof. Aries Kovoor on his 81st birth anniversary, 3rd March 2008.
A memorial speech and scientific papers will be presented by leading scientists.

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