

The evolution of a surgeon and innovator: M. S. Valiathan

Marthanda Varma Sankaran Valiathan is a celebrated cardiac surgeon, scientist, administrator and author. He was instrumental in transforming the Sree Chitra Tirunal Institute for Medical Sciences, Thiruvananthapuram, from 'just a building' to an Institute of National Importance and in developing the Chitra-TTK heart valve—the first indigenous heart valve of our country. He is currently involved in a project that seeks to study, in terms of basic sciences, problems that have been inspired by Ayurveda. The following is a brief outline of his varied career that spans more than four decades (Box 1).

Early years

What made you interested in surgery?

When I was a first-year medical student in 1951, I had no particular preference. But in our library, I came across a book called *Surgery: Orthodox and Heterodox* written by a British surgeon called Ogilvie. He was a good writer and the book was a collection of essays. He wrote in a highly impressive style about patients coming with appendicitis, or a fracture or bleeding. Once you corrected them they were okay and would go back to work! When I read that, I thought, 'This is what I'd like to do'. Sushruta also says something like this, that surgery is the noblest of sciences. So from the very first year, without seeing any surgery (laughs), I got interested, and the interest grew.

In those days Kerala had no post-graduate training in surgery: in India itself there were only a few places for surgical training. I couldn't go to Chennai or Mumbai, and had to go abroad. In the fifties, most of us went to the UK; very few went to the United States for surgical training. I went to Britain. That was a great experience for me. For instance, they showed us the importance of comparative anatomy. If you want to study, for example, the shoulder joint, we only looked at the human joint in Trivandrum. But in the Royal College, they looked at the shoulder joint of the monkey, the wings of birds, their structure and function, and how they had evolved... that gave us a biological per-

spective. We learnt anatomy in a totally new way, which was exciting. And then of course, watching great surgeons, assisting them, was also a great learning experience.

I became a Fellow of the Royal College of Surgeons in 1960. That is the stamp of recognition of becoming a surgeon. I worked in general surgery until 1965, when I decided to specialize, as general surgery seemed to be shrinking.

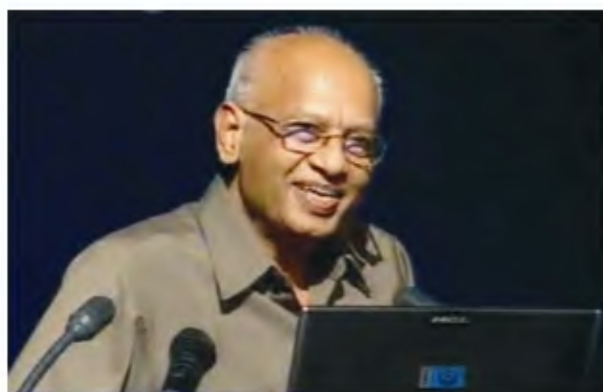
After my first visit to the UK and the US for five years, I came back and joined PGI in Chandigarh. It was then that I decided to take cardiac surgery. In cardiac surgery, more than in any other specialty, the technology content is high – far more than general surgery or plastic surgery. If you simply want to do cardiac surgery, you don't need to know much about technology; just like if you want to drive a car, you don't have to know about the engine design. But if you want to know

how the graft is made – after all, it is a porous tube that you are putting in for a blood vessel, but it doesn't leak – how does that happen; how does a graft made of foreign material stay in the body, let blood flow through, and not fall apart? If you ask questions, it makes it very interesting. I was never satisfied

'I should dearly love to say that I wished to become a surgeon when I was a school boy and that I had enjoyed dissecting dead frogs and looking after sick animals. But I grew up with no such ambition and no clear goal. My family tradition in medicine had been strong for over two generations... I grew up on an unstated assumption that I would follow the family tradition.'¹

Box 1. A brief biographical sketch.

M. S. Valiathan was born on 24 May 1934. He had his early education in Kerala. In 1951, Valiathan was in the first batch of MBBS students admitted to the Trivandrum Medical College, and he later went to Liverpool University, UK, as a surgical trainee. After a brief stint as a faculty member at the Post-graduate Institute of Medical Education and Research, Chandigarh, Valiathan underwent advanced training in surgery at the Johns Hopkins University, UK, and Georgetown University Hospital, USA. On returning to India in 1972, Valiathan served for brief period at the Safdarjung Hospital, Delhi, and at the Indian Institute of Technology, Chennai. In 1974, he took over as the first Director of the newly built Sree Chitra Tirunal Institute for Medical Sciences and Technology, Thiruvananthapuram, where he served till 1994. In 1994, Valiathan became the first Vice-Chancellor of the Manipal University. He was President of the Current Science Association from 1994 to 2000 and of the Indian National Science Academy from 2002 to 2004. Valiathan was honoured with the *Padma Vibhushan*, India's second highest civilian honour, in 2005.



M. S. Valiathan delivering the 15th G. Ram Reddy Lecture on 2 July 2010.

simply doing surgery. Surgery is good – you are helping people; that is the heart of the specialty. But that's not the only thing.

Experiences in Johns Hopkins and Georgetown University with Vincent Gott and Charles Hufnagel

Gott developed a prosthetic valve in Wisconsin where he was working before he came to Hopkins. But it was not successful and he gave up the valve project. His brilliant contribution was the graphite–benzalkonium–heparin coating of materials. It was not a planned development, but became the first wall-bonded heparin. Heparin could stay in the coating for long periods and ensure that blood would not clot on it. It was a great contribution: it was published in *Science*. It was opening up a whole new field – blood-compatible surfaces.

Hufnagel, at Georgetown, was also a great pioneer; he developed and used an artificial heart valve for the first time. Hufnagel's was a leaflet valve when I joined him. I doubted whether it would succeed – in two or three years, in fact, it was given up. He had developed a disc valve earlier – a caged disc – moving up and down and not tilting. His first model was a ball valve, which was historic. He was constantly developing new designs and new devices.

Returning home

What made you come back to India after being in the US and UK?

You see, I *like* India. I like to live here. I spent 12 years in UK and US and was very happy – I was lucky to work with great surgeons, teachers whose lectures were stimulating, the quality of life was very nice... Externally I was at peace. But internally, I was always an alien. I couldn't overcome that feeling. I was looked upon as an alien; I regarded myself as an alien; and I couldn't imagine living as an alien all my life (laughs). I *belong* here. But externally I am in revolt here constantly – I don't like these traffic jams, lack of discipline, squalour, corruption – anything! But internally, I am at peace.

Returning home was difficult. I had no regular job, and joined Safdarjung Hospi-

tal, Delhi, for a year as an ad hoc cardiac surgeon. Then I was appointed as an Honorary Consultant at the Railway Hospital, Chennai, with an honorarium of Rs 200 per month (laughs). I was a visiting professor of Biomedical Engineering in IIT in a concurrent appointment. This arrangement lasted a year, and then I moved to Chitra in Thiruvananthapuram. It had an unfinished building, no furniture or equipment, and no staff! It was a hard beginning.

I remember an incident in 1971, the year before I came back. P. K. Sen of Mumbai was a person whom I had long admired – very innovative, a great cardiac surgeon; he had an original mind. He came home for dinner during an American visit and, in the course of a long chat, asked me, 'Valiathan, what are you planning to do now?'. I said to him with some regret, 'I keep on writing letters, nobody replies'. I didn't want a professor's job. I was willing to come to India as a lecturer. But nobody would even reply! So I told him, 'I am a Hunterian Professor, but they are not calling me'. But Sen was very blunt and said: 'India owes you nothing. Do you realize that half our people have nothing to eat? You expect to come to India, have a hospital ready for you to work – blood bank, cardiac theatre, the lot. If you are serious, come and struggle like me.' What he said was hurtful, but he was right. If I had stayed on in the US, I would have probably done more surgery and published more papers in top journals. But we get a different species of satisfaction by serving in India. In Kerala, there was hardly any cardiac surgery, no research and development, and no training programme. Today, all these are flourishing there. A factory produces over 1200 tilting-disc heart valves a month, supplies the Indian market and even exports the device. In other words, you could build capacity, where none existed. This was unthinkable in the US. Many people seem to think that Indian doctors like myself sacrifice big things in the US by returning to India. For me, it was no sacrifice as I liked to come back. This is my place where I love to live and work. Where is the sacrifice in coming home?

Experience on coming back to India

A serious problem was the difference in the nature and requirements of my work

abroad and in Thiruvananthapuram. In Johns Hopkins and Georgetown where I worked, I was lucky to come in contact with a number of people. Because of their interest, I was learning and working with them. It was as if I was learning to dance then, without the least idea where I would eventually have my performance, if at all! When I came to Chitra after several stops, suddenly I realized that this is what I have been trained for. Here, things were too costly. In Thiruvananthapuram in those days, one valve was Rs 8000. The State Government would give you a fixed amount of money. With that, I could only do 20 operations. But I had 200 people waiting! I recognized, of course, that the price of the valve was only one item in costing valve replacement – but it was an important item. If we could reduce the cost by designing and making a valve – by intelligent copying of an existing valve, to use Ramaseshan's famous phrase – we could make a useful contribution by increasing the access to valve replacement surgery. But for R&D, you need materials, you need a design, you need to do all the tests, you have to adhere to international standards – you cannot dilute them. Then, you'll have to find a manufacturer who will manufacture it, with the necessary quality. It is difficult... it took us nine years to develop the Chitra valve!

What made you go to Chitra Institute?

When I came to India, my major problem was getting a job! At Safadarjung, I had an ad hoc appointment for a year, and I could neither do cardiac surgery nor any research. I moved to Chennai, where I was a visiting professor at IIT and an Honorary Consultant in the Railway Hospital. In IIT, I was disappointed to find that development of hardware had low priority. You could teach all about aircraft, but could not develop an aircraft prototype for testing. In the Railway Hospital, my role was limited to operating three days a week; I had no role in the pre- and post-operative care of patients and could do no research. So this was not a viable proposition. I was almost 40, and had to look after my family. Many friends and colleagues, including Hufnagel, believed that I had made a foolish mistake in opting to leave the US. At one stage, I even seriously thought of

going into private practice. You can make money, forget all about research. Then, totally unexpectedly, a call came from the Kerala Government. They had a building gifted by the Maharaja, which the Government wanted to develop into a hospital for specialties. I was intrigued that the hospital project was sponsored by the Department of Science and Technology, and not by the Department of Health. The then Chief Minister, Achutha Menon, was a remarkable person. He gave me freedom and authority to set up the hospital, which admitted patients in less than two years for cardiac and brain diseases. Around the same time, we also got started on the development of cardiovascular devices.

The Chitra experience taught me many things, but it suggested to me the existence of a pattern in life. I was struggling all along in Delhi, Chennai and elsewhere, but failed to find a work place where I could do what I wished to. In Thiruvananthapuram, I was struggling as usual. But things started moving, suddenly! Buildings came up, equipment was installed, the hospital hummed with activity, professionals and students came from all over India, and Chitra became an Institute of National Importance by an Act of Parliament within five years after I joined. A familiar scene would be in an international airport where you walk along a long corridor, luggage in hand, looking for a distant gate. As you trudge along, you would suddenly find yourself on a conveyer belt which would take you in seconds to your distant gate. Shakespeare said, 'There's a tide in the affairs of men...' This is what he meant. But to step on the belt, you have to keep walking and always have your gate in view.

Evolution of the Chitra valve

Could you share with us your experience while developing the Chitra valve?

Many people believe that in countries like India, it is easy to get cadavers and you could harvest fresh valves to produce homograft valves. The fact is that Indian society is not ready to offer cadavers for harvesting organs even today! For so many of them, there are no autopsies. You can, with great persistence, collect a few cadavers. But here, we are talking about thousands of valves

of different sizes – an industry. The other biological alternative is valves taken from pigs. In US, valve manufacturers have agreements with abattoirs which are licensed, and collect the hearts of slaughtered pigs in special bags supplied by the company everyday. Eighty per cent of the valves are rejected during inspection because of defects in the leaflets, abnormal structure, etc. The rest are specially treated to minimize antigenicity and enhance mechanical strength before being mounted on stents of different sizes. These steps are complex and expensive, which account for the higher price of porcine valves over mechanical valves. In 1975, Kerala had one licensed slaughter house which slaughtered less than 200 animals per month. Where is the question of getting enough number of valves? So we decided on mechanical valves. Tilting-disc design, according to us, was the best because it had a low profile and had an excellent track record. But there were a number of questions

such as the suitable materials for the three components of the valve – housing, tilting disc and sewing ring, test set-up, animal model for trials, etc. Ramaseshan took a keen interest in the development of the valve from the early stages and helped us in trouble-shooting from time to time. For a crystallographer, his understanding of materials and mechanical engineering was remarkable. Bhuvaneshwar, my student from IIT, was the leader of the valve project. He was ably supported by Ramani who headed Chitra's R&D wing.

Chitra-TTK valve is now a success story – 60,000 valves have been implanted in patients, and over 1200 are being produced monthly by TTK in Thiruvananthapuram. I believe their facility is being certified by EU and valves are being exported to several countries such as South Africa. For a difficult enterprise to succeed, I believe those who take the plunge should have a motivation beyond material gains (see Box 2). There is an

Box 2. The Chitra-TTK valve

The Chitra valve that is now commercialized is the fourth model that was developed. Describing the three earlier models, Valiathan says, 'In model 1, the major and minor struts were electron beam welded and the valve was expected to withstand 360 million cycles of disc movement. To our dismay, the major strut fractured at the weld after a mere 100,000 cycles. It turned out that weld embrittlement was the cause of fracture. In model 2, the disc was made of single crystal sapphire which was inert and blood compatible. The housing was carved out of a block of titanium. This model failed because of the extensive wear of titanium struts and the escape of the disc. Model 3 had a housing made of a high wear-resistance aerospace superalloy, called 'Haynes-25' (a cobalt-based alloy with chromium, nickel and tungsten). This model went through all the tests successfully and several sheep were alive and well for months. . . But one animal which had valve replacement three months earlier dropped dead suddenly. Necropsy showed that the sapphire disc had fractured. We were faced with a major crisis after a decade of toil when critics, including the media, did not spare us or our effort.'¹



The Chitra-TTK valve currently in use

old story of three stone masons. Somebody went and asked the first mason, 'What are you doing?' He said, 'I am carving granite. I am paid 50 rupees a day'. Then he asked the second man who said, 'They are making a temple, and I am carving granite. I am paid 50 rupees.' He asked the third man. He said, 'It is a Shiva temple, and Shiva has a bull – Nandi. At the moment, I am carving Nandi's eye that is always focused on his Lord. I am paid 50 rupees'. Now, if you look at the third man, he is getting far more than the 50 rupees, and that will reflect in his work also. So when you talk of valve replacement, you can buy it from the market and put it in. There's no need to know how it works. But you get far more out of it if you have actually developed it.

At the helm

What were your priorities when you became the Director of the Chitra Institute?

The hospital was our first priority. Kerala then had few facilities for the care of cardiac and neurological patients. Going to Chennai or other cities or abroad was no option for poor patients. I also knew that without the opening of hospital services one had little chance of obtaining the support of the Government for R&D activities. Once the hospital opened and quickly earned a good name, R&D on biomaterials and medical devices began with initial support from SERC. Teaching programmes for DM/M.Ch started only after Chitra became an Institute of National Importance by an Act of Parliament in 1980. That was Prime Minister Morarji Desai's decision. He somehow took a liking to me (laughs).

And as the Vice-Chancellor of Manipal University?

That happened in 1994 when I was sixty. I had completed 20 years at Chitra, and the time to quit had come. I met Ramdas Pai, MD of Kasturba Medical College, at the Mumbai airport and he said to me, 'I heard you are leaving Chitra, why don't you come to Manipal?'. My wife had been a professor in the Dental College of Manipal, and I told Pai that I would get back to him after consulting her. She was positive and the die was cast. When noti-

fied as a Deemed University, Manipal Academy of Higher Education (MAHE, today's Manipal University) had only five colleges – dental colleges in Mangalore and Manipal, medical colleges in Mangalore and Manipal, and the nursing college. They were all affiliate colleges of Mangalore University. Actually, a family managed the colleges; the decisions were all from the family. And the academics were handled by the University – all kinds of informal ways of doing things. The University Grants Commission has a model – how things should be done, how it should be structured, etc. That was the difficulty – I had to convert those colleges to conform to the rules.

I also had the opportunity to start new initiatives. Manipal Life Sciences Centre, where I now sit, is an example. Medical Colleges in India have traditionally focused on the training of physicians; research was never a priority. But a university by definition has to give equal priority to research, which was accepted by MAHE. It was decided that our Life Sciences Centre would focus on modern biology in relation to cancer, infectious diseases and ageing. The building was, in fact, designed by CCMB. Then, we started an Institute of Communication and MIT (Manipal Institute of Technology). Pai is a highly innovative person. It was his idea to bring in other campuses – in Nepal, Sikkim, Malaysia.... In my long years in the public sector, costing of projects was seldom done professionally; it wasn't even seriously considered. If you wrote the Annual Plan estimates satisfactorily, money would come. In Manipal, I learnt the importance of costing. A financial plan, prepared professionally, was indispensable for every project. Bank loans had to be serviced and capital repaid, which never bothered one in the Government sector!

You have been many different things – a surgeon, researcher, administrator, author... which role did you like the most?

For me the roles of surgeon and investigator are combined, two sides of the same coin. I was operating everyday on patients when my colleagues and I were heavily involved in the development of the tilting-disc valve. That is the role I liked best. Administration, to an extent, was necessary and even enjoyable. I could not have done what I did in Chitra

had I not been administering the Institute as Director.

Ayurveda

In your autobiographical article in the Journal of Biosciences, you had mentioned that your family had a medical background and that's how you got into medicine. Was your family background also important for your getting interested in Ayurveda?

I grew up, like many middle-class families in Kerala, in an Ayurveda-friendly environment. A relative of my father was a reputed Ayurvedic physician and neighbour, and he treated us for all common ailments. We would think of a hospital only if surgery was considered necessary or the Ayurvedic treatment was not effective after a week or so.

You learnt Sanskrit in school?

Yes. But that is not sufficient to understand Ayurvedic texts. To improve my proficiency, I took the excellent self-instruction course called 'Kamadhenu'. It was prepared by Bharatha Pisharoty many years ago, and he guaranteed that anyone who took the course seriously would gain proficiency to understand the *kavyas* of Kalidasa in 40 days! But 40 days is... you have to spend practically 18 hours a day (laughs). But certainly it is a great help.

When did you do this course?

As soon as I finished my Vice-Chancellorship in 1999. I always had a love for Sanskrit. I used to read... I could follow simple Sanskrit. But though I grew up in an Ayurveda-friendly environment, I knew nothing about it. When I entered Medical College as a student for MBBS in 1951, the atmosphere was hostile to Ayurveda, and I lost all interest in the subject. Like my fellow students, I too thought that Ayurveda was not scientific. All through my 30 years as a surgeon, I paid no attention to Ayurveda. But in 1990, when I was still in Chitra, Kottakal Arya Vaidya Sala asked me to give a Founder's Day Lecture to commemorate Vaidyaratnam P. S. Varier, who pioneered the revival of Ayurveda in the early 20th century with other leaders such as

Lakshmiopathy and Gananatha Sen. It was an unexpected invitation and I was honoured to be asked. I decided to speak on Sushruta – a pioneer of surgery in ancient India, and one of the ‘great three’ of Ayurveda. I read *Sushruta Samhita* with the commentary by Bhishagratna and understood enough to give the Memorial Lecture.

Two years later, I was invited to give the Gandhi Memorial Lecture, which was started by Raman, at the Raman Research Institute, Bangalore. Throughout Raman’s life, he used to give the lecture every year; nobody else. After he passed away, lesser mortals were asked. Ramasethan asked me to give the lecture. It was a great honour. The name – *Gandhi Lecture*... *Raman’s Institute*... I could speak only about a medical theme. It didn’t make sense to give a lecture about John Hunter or somebody; it had to be an Indian. Immediately, I thought of Charaka. That was the time I got the *Charaka Samhita* – P. V. Sharma’s translation. I needed translation, because *Charaka* is pretty difficult, unlike *Sushruta*. When I read that, the first thing that struck me was, there is a lot more than medicine. There is a great deal of philosophy, ethics, education... But it is unstructured, like a series of seminars all put together. My lecture was well attended and the audience included many of the leading scientists. When I came down from the podium, Satish Dhawan put his arm on my shoulder and said, ‘Valiathan, I had heard Charaka’s name many years ago, but had no idea that such thoughts had been conceived in this country. You must write on this.’ (see ref. 2 for the lecture). This happened before my move to Manipal. During my Vice-Chancellorship, it was impossible to study the ancient text. The time came when my five-year term ended in the university and the Homi Bhabha Council awarded me a Senior Fellowship to pursue my study. I remember the many discussions I had with R. M. Lala of the Dorabji Tata Trust on Ayurveda and Charaka during that period. I also got the ‘Kamadhenu’ and worked hard on that. But it is not enough if you have a nodding acquaintance with Sanskrit. I was dealing with a big subject, Ayurveda, which I had not studied. So I needed a scholar to help me. When I developed an interest in Ayurveda, I had read in Malayalam very nice books called *Ayurveda Parichayam* – acquaintance with Ayurveda, written by Raghavan Thiru-

mulpad. I found them extremely lucid, very well written – I thought he’s the person that I should ask. I met him in his village and sought his guidance in my proposed study of Charaka. He did question me on why I had approached him as he had not studied science or modern medicine, while I had spent my lifetime in surgery. When he saw I was a serious student, he graciously agreed to guide me. Our mutually agreed protocol was for me to inform him in advance of the chapters I had studied, and have a discussion for two and a half hours on my understanding of what I had studied every two or three months. This would invite comments and suggestions for corrections, clarifications, textual improvement and so on. It became an enjoyable and stimulating exercise. But I had to unlearn many things. If you want to learn Ayurveda, you cannot learn it through modern medicine. As Raghavan Thirumulpad himself said, if you want to learn Sanskrit, you cannot learn it through English grammar. Likewise, if you want to learn Ayurveda, you have to learn it according to their own framework (see refs 3 and 4 for detailed expositions on Ayurveda, and ref. 5 for an editorial on Ayurveda in *Current Science*).

On his current work

Many people try to understand Ayurveda through modern science. . .

I would say that is inappropriate and futile. What seems interesting and feasible is to study chosen concepts, procedures and products of Ayurveda which con-

tinue to be in vogue after 2000 years using the tools of modern science. The choice is not easy because the chosen concepts, procedures and products should be amenable to scientific scrutiny and experimentation. During my study of the three basic texts of Ayurveda, *Charaka*, *Susruta* and *Vagbhata*, over a nine-year period (2000–2009), I had the opportunity to select a few subjects for scientific investigation (Figure 1). The methods for these studies are those of modern science but the cues are drawn from Ayurveda.

There are a few categories of research in Ayurveda. One relates to herbal drugs, development of molecular drugs from herbal extracts, and so on. This is the oldest category going back to Ramnath Chopra, and claims 90% of ongoing research in Ayurveda. Pharmaceutical companies, CSIR, Pharmacology Departments, MNCs are all into herbal drugs, even though we have not come up with any major drug. None of the plant-derived drugs we use, such as emetine, codeine, ephedrine, etc. is obtained from Indian plants. We have nothing comparable to artemisinin of Chinese medicine. Another area of research involves trials of Ayurvedic drugs and procedures for safety and efficacy. WHO has liberalized the criteria for the trial of traditional medicines which are no longer required to undergo randomized, double-blind controlled trials. A patient can be used as his/her own control in the approved study design. That is, before the treatment you record everything, give the treatment and then you take readings again. Similarly, a black-box approach – an Ayurvedic treatment may involve an

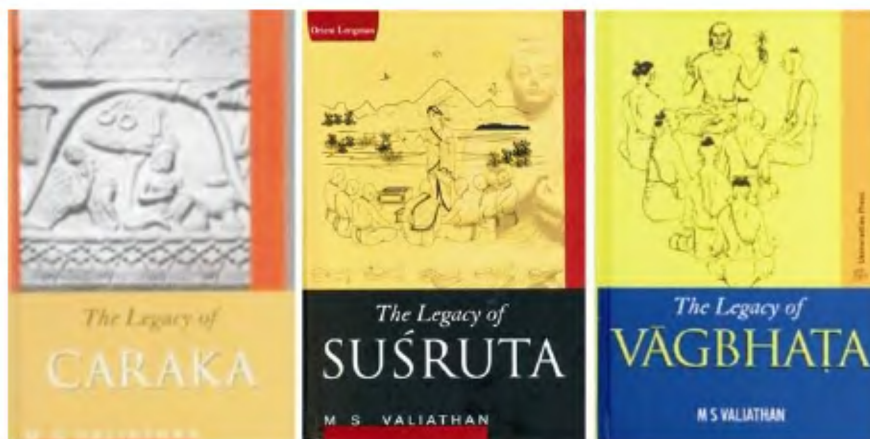


Figure 1. Books on the ‘Brihat Trayee’ by Valiathan.

oil massage, some dietary restrictions, three different medications being given etc. All that put together is the black box. Now in modern medicine, you'll want to know each one of them separately. But in traditional medicine, it is not so. The inclusion criteria of the patients, diagnosis – all that must be correct. Once that is done, in the treatment part, no questions are asked. In spite of the liberalized regime, hardly any trials are done in India and few are published.

Why is that, sir?

I don't know. There is no place where physicists, chemists, immunologists and molecular biologists can interact with the Ayurveda people. They know nothing about Ayurveda. Ayurveda knows nothing about science. P. C. Ray, one of the great pioneers of chemistry in India in the 19th century, who wrote the *History of Hindu Chemistry*, calls 600 BC to AD 800 the Ayurvedic period. He calls it that because Ayurveda is not only the mother of medicine, but it is the mother of all life sciences in India. In spite of it, science has been completely divorced from Ayurveda. But these are the interdisciplinary areas that advances *will* take place in.

About the Science Initiative in Ayurveda project

Chidambaram, the Principal Scientific Advisor to the Government, readily saw the problem in funding interdisciplinary projects even when they appear promising. Under a scheme 'Directed Basic Research' launched by his office, he agreed to give initial support for a few refereed projects which would consist of scientific studies based on cues from Ayurveda. If the projects showed good progress, they could be transferred to funding agencies in due course. This was the beginning of 'A Science Initiative in Ayurveda' (ASIIA). We had a brainstorming session of a small group of sci-

entists in Chidambaram's office followed by a larger discussion meeting in IISc, which was attended by Ayurvedic physicians, scientists and representatives of Government agencies which dealt with Ayurveda. The problems in formulating projects are not small. The first problem was to identify concepts or procedures which would lend themselves to basic sciences. Having identified a topic, the second was formulating an experimental protocol, which could be implemented by any group. The third problem was to find competent scientists familiar with accurate techniques and fine Ayurvedic physicians who are open to modern science. The meeting in IISc and many subsequent discussions among stakeholders claimed two years. ASIIA was launched finally in 2007.

We selected five problems for the first round of studies. To give an outline, *doshaprakritis* – *vata*, *pitta* and *kapha* – are fixed at conception and remain unaltered throughout life. They influence the manifestation of diseases and response to treatment. Do they have a genomic basis? Can that be studied by looking at molecular markers such as SNPs, gene expression and epigenetic changes? Secondly, do plants which differ taxonomically and morphologically but share anti-*dosha* activity, have something in common at the pharmacologic or genomic level? Thirdly, does *panchakarma* therapy induce metabolic and immunologic changes in the body? Fourthly, does *rasayana* therapy enhance the rate of repair of DNA chain breaks in the rat and human models? Does it have anti-aging activity in genetically engineered drosophila? Finally, *bhasmas* prepared from mercury are claimed to be non-toxic; could their microstructure hold the key to the riddle of non-toxicity? All these studies are carried out by competent scientists and Ayurvedic physicians in reputed scientific institutes and universities across India. We are in the third year of these projects, and some of the studies are over and have given interesting findings. We expect to have

at least four papers from these studies submitted to good journals later this year. ASIIA has also been taken over by DST as a regular programme in Ayurvedic biology for funding.

Medical education and innovation – some thoughts

Views on interdisciplinary research

Today, to my mind, any major progress will only come through the interdisciplinary route. A doctor or engineer may confine himself to his own discipline and make progress, but progress of a different class occurs when they interact and collaborate to produce concepts, instruments, devices, and so on. It is not necessary for a person to be formally trained in both engineering and medicine. It is enough if a doctor interested in medical devices takes the trouble to understand as much as he can of the technology of devices, discusses the topic with materials scientists, mechanical engineers and so on. When this interaction is continual and close, the doctor would get a working knowledge of materials over three or four years without becoming a materials scientist. Similarly, the scientist and engineer too would acquire a working knowledge of the medical applications of devices. A joint culture and common vocabulary will gradually evolve and make them understand each other easily. This approach is essential in interdisciplinary work.

If something like this is worked out for Ayurveda...

We hope it will happen, but will take time.

In many places, you have said that innovation is lacking in India, and that medical education leaves much to be desired. Could you tell us how the situation can be improved?

Medical education has reached a terrible situation. In its Platinum Jubilee year, the Medical Council of India was dissolved by the Government of India! How did it come to this, and what should we do now? In the G. Ram Reddy Lecture that I recently delivered, I gave suggestions as to what they could do. But

'To ignore the testimony of thousands of patients over many decades is reminiscent of the derisive attitude of Jenner's contemporaries in Gloucestershire who despised the claim of milkmaids that cowpox gave them protection from smallpox! When Jenner wrote to his mentor, John Hunter, on the observed facts and the arguments against it, Hunter gave his famous reply, 'Why think? Why not experiment?' That applies to Ayurveda, whose time to experiment has arrived⁶.'

there's a great reluctance to make a radical break. We always try to make a marginal change.

Take a look at the present medical curriculum... In medicine, there is a classification – preclinical, paraclinical and clinical. Preclinical deals with anatomy, physiology, biochemistry, etc. – the first year. Then paraclinical – cytology, pharmacology, public health and policy. And then, two clinical years when the student learns clinical subjects in a teaching hospital. If you look at it from the education point of view, anatomy, physiology and biochemistry are all essentially science subjects. So it should be treated just like any other science subject. There must be PhDs. But in our medical colleges, these subjects have been downgraded over the years to such an extent that few students opt for them, few teachers are available, and non-medical scientists with PhD are even barred from heading these departments! Those who obtain MD in these subjects by examination after medical graduation have little experience in research; yet they fill faculty positions which run into thousands as we have over 300 medical colleges. They submit few proposals for research grants, publish few papers, seldom collaborate with clinical departments in formulating research projects, and fail to motivate students for scientific enquiry. ICMR found a few years ago that out of 280 medical colleges, 180 published no papers. I am quoting from memory. When you realize that medical education claims the cream of young students at the 10 + 2 level, you would see the colossal waste of talent in medical science in this country.

One of the suggestions I made in my Ram Reddy Lecture was to introduce integrated MD, PhD programme for teachers in pre- and paraclinical subjects which are laboratory-based. The integration would involve restructuring the MD and PhD courses over five years in close

'A university, as Yashpal's report says, is a comprehensive term. It comprehends all types of knowledge. Somehow in India we have managed to fragment them to such an extent – we have medicine, pharmaceuticals, pharmaceutical sciences – they are all becoming smaller and smaller and becoming universities.'

'Western medicine came to India in the 19th century. But in two centuries, I cannot think of any advance, or a contribution, made by an Indian physician which has had a global impact like Raman spectroscopy – it was developed by Raman in Calcutta, but it is used all over the world. Is there an equivalent in medicine? The fact is, there is none'⁷.

collaboration between medical colleges and university departments. It would call for changes in curriculum, training requirements, appointments of university professors as Adjunct Professors in medical colleges, posting of medical postgraduates in university departments for project work, redefining thesis requirements and so on. If 50% of all pre- and paraclinical departments are staffed by MD PhDs who are trained to do independent research, in 10–15 years, medical education would be revolutionized in India. Similarly, there is a whole lot we need to do to revise our process of curriculum development. It should not be based purely on round-table meetings, but should involve educational experiments and innovations. All the advances in medication education – problem-based learning, computer-assisted learning, simulation, objectified examination – emerged from developed countries which have fewer medical colleges than we have. This situation is unacceptable and must change.

What would be your message to present-day medical students?

One thing that all of them should know is that patients' safety and patients' health is the most important thing. If you are not interested in that, don't take medicine. You cannot give the same advice to

all medical students. They are different. Some are interested only in patients. Some are interested in medical science. If you are satisfied with taking care of the patients and you don't want to do anything else, it's fine. We need lots of people who are general practitioners. But many good people can do other things also. If you have that kind of an attitude, you may get only 50 rupees like that granite cutter; but you'll find your work very, very satisfying.

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V. T. Yadugiri (*S. Ramaseshan Fellow*),
H. No. 1184, 5th Main, Sector 7, HSR
Layout, Bangalore 560 102, India.
e-mail: vtyadugiri@gmail.com