

the  $\mu$ -theory of superconductivity<sup>5</sup>. At the Lebedev Institute<sup>10</sup> he concentrated on three areas, namely condensed matter physics, plasma physics and astrophysics. In the field of condensed matter physics, he focused on the theory of segnetoelectricity, phase transition and Ginzburg–Landau theory; in plasma physics, he studied the propagation of waves in plasma, theory of synchrotron emission and theory of transition radiation; and in astrophysics, the origin of cosmic rays, theory of pulsar radio emission, and black hole electrodynamics. He formulated the theory of transition radiation with I. M. Frank and the relativistic theory of higher-spin particles with I. E. Tamm.

Ginzburg passed on his legacy in physics to his daughter Irina (with his first wife, who also studied physics), and grandchildren. Irina studied the history of physics, and married Lev Dorman, a specialist in cosmic rays. One of their two daughters, Viktoria Dorman is also a

Ph D in physics and married to a physicist.

Ginzburg once wrote: ‘... no educational institute would make one into a very good writer, physicist, or mathematician, unless he exhibits the corresponding aptitude’<sup>2</sup>. He also considered luck, health, ‘timely read article or book’ and ambition as keys to success<sup>2</sup>. He stressed on the importance of school education in his writings and interviews. His contributions to physics will always be remembered.

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## S. S. Sriramachari (1925–2009)

Samavedham Srinivasa Sriramachari, popularly known as Dr Chari, passed away on 25 December 2009. He was one of India’s celebrated medical scientists born in the era of colonialism when medical history in India was marked not only for discoveries of the malaria pathogen by Ronald Ross but was also an age when diseases peculiar to the subcontinent were grouped generically as ‘tropical diseases’. History got rewritten when a band of post-independence medical doctors such as Chari investigated the local diseases with fresh minds.

Chari was born on 25 June 1925 and had his early education in St Joseph’s Convent, Waltair and Maharaja’s College, Vizianagaram followed by Andhra Medical College, Visakhapatnam where he obtained MBBS and MD degrees in 1948 and 1955 respectively. Chari acknowledged the influence of M. D. Anantachari in arousing his interest in liver diseases during this period, an interest that lasted a life time. He joined the Nutrition Research Laboratories in Coonoor in 1951. It was here that some of the best work on kwashiorkor and protein calorie malnutrition was undertaken by the tri-

umvirate of V. Ramalingaswami, C. Gopalan and Chari. They laid the foundation for our understanding of malnutrition and gave remedial and preventive guidelines to the nation. He moved to



Delhi in 1962 on deputation to the ICMR headquarters and never left it, serving the organization in various capacities. He was an institution builder. Seeing the

need for pathology research in India and having observed the impact of disease databases abroad, he founded the Registry of Pathology in 1965 in two rooms of Safdarjung Hospital. With unstinting efforts he developed it into the current Institute of Pathology (IOP) which conducts research in cancer, leishmania, chlamydia and placental models for pollutant monitoring. He was appointed as the first Additional Director General of ICMR and returned to IOP and worked there till his death.

One is enriched and amazed at the breadth of investigative pathology undertaken by Chari, traversing as it did nutritional, liver, muscle and bone pathology with ease, not to mention his interest in colour photography. His publications cover kwashiorkor, varieties of fatty liver, Indian childhood cirrhosis on which he was an authority, non-cirrhotic portal fibrosis/hypertension another disease brushed off earlier as a ‘tropical’, effects of Vitamin D on bone mineralization, fluorosis, types and causes of cerebral oedema and neurolathyrism. His approach to diseases was characterized by not only the questions asked but the

innovative techniques developed to answer them. He did not limit himself to bio-medicine but crossed into disciplines outside the purview of most doctors. He would use chemical and physical principles to understand medical problems much to the surprise of conventional pathologists of that time. Chari was the first to do large-scale liver biopsies and liver function tests. He was one of the earliest to develop histochemical staining to study chemical alterations in cells and experimental animal models to understand disease process and to reverse the pathology thereby providing a solution for amelioration. He looked at rat and monkey models to understand liver damage and effects of malnutrition which continue to plague us even now. He showed that though there was fat in the liver cells in both childhood cirrhosis and protein deficiency, in the former it led to the serious condition of cirrhosis whereas in the latter only mild fibrosis/scarring was noted. He was also able to show that these were reversible by appropriate dietary replacements.

Chari combined good science with intense nationalism and was at the forefront whenever the country faced adversity. He was called to Delhi by C. G. Pandit, the ICMR Chief, when Sino-India war broke out, to institute research in high altitude-related problems of our soldiers. He investigated the deaths following the Kanishka Air Crash as well as the death of Sivarasan involved in Rajiv Gandhi's assassination. Similarly, when there was public concern about the ill-understood child deaths in Nagpur in 1970 summer, Chari established the presence of brain oedema through autopsy studies and linked it to heat pyrexia and not encephalitis. He went on to develop monkey models to prove this association and demonstrated that cerebral

oedema was a critical but reversible factor not only in heat strokes but also head injuries. His desire to produce affordable teaching slides and save foreign currency made him spend many years perfecting a teaching set of pathology slides for medical colleges of India. Even here his curiosity and lateral thinking overtook him to investigate the principle of colour reproduction and the influence of light and dyes that would give the best results.

Perhaps, Chari would be best remembered for his research on the infamous Bhopal gas tragedy and the worst industrial disaster of the world that hit the Union Carbide Factory in Bhopal in December 1984. He was one of the first to reach Bhopal and conducted hundreds of autopsies. Chari showed unequivocally the excretion of sodium thiocyanate, a metabolic product of cyanide, in the urine of the patients. Following double blind clinical trials, ICMR formally recommended thiosulphate treatment to the surviving victims. However, 30% of the patients showed relapses and even when the degree of lung damage was not sufficient to explain the symptoms. These patients also responded well to subsequent administration of sodium thiosulphate. Even though Union Carbide declared that MIC does not cross the alveolar barrier in the lungs, Chari showed that MIC bound to the blood/haemoglobin and tissues by a process of N-carbamoylation of amino acids thereby reducing oxygen affinity. He further showed that chronic symptoms of muscle weakness and respiratory problems were explainable by endogenous release of cyanide occurring through S-carbamylation of glutathione, leading to impairment of enzymes such as rhodanase and esterase. The work of the Indian investigators broke the earlier myths about MIC effects on tissues. In later years along with his colleagues in

IOP, he was preoccupied in developing better tools for toxicology. With Jain, he explored the uses of placental tissue to detect environmental pollutants as it seems to be a store house easily available since it is discarded after child birth.

When many were paying tributes during the 25th anniversary of the Bhopal tragedy, Chari spent the terminal period of his life driving himself to complete the ICMR report. He gave a memorable lecture sitting in a wheel chair connected to oxygen supply and surrounded by anxious physicians. He deteriorated physically thereafter but his mind was sharp.

Chari was a man of contradictions like many thinkers. He often joked that he was a Tamil but not a Tamilian as he never lived in Tamil Nadu. His steely determination to reach his goal belied his polite exterior. His unending curiosity, demand for perfection, and lateral thinking, apparently diverting from the main path of investigation, drove many of his colleagues to distraction but brought scientific dividends. Like his forefathers he was well-versed in Sanskrit. His loyalty and commitment to ICMR was legendary and went beyond the call of duty. He also dedicated research awards for the young doctoral students of IOP.

He leaves behind his daughter Sandhyamani, who followed his footsteps to become a pathologist and his doctor sons Murali and Krishna. His wife Pushpa died decades earlier due to a drug reaction and is remembered by a memorial lecture instituted by Chari.

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