William Trager (1910–2005)

William Trager, Rockefeller University, USA, a researcher who spent his entire professional career studying the biology of animal parasitism died on 22 January 2005 at his home in Manhattan, New York. He was one of the world's leading authorities on parasitic protozoa.

Trager had great admiration and inclination for India. Many Indian scientists had visited his Laboratory of Parasitology and a few even worked for long durations. Late B. R. Seshachar[1] (Professor Emeritus, Centre for Theoretical Studies, Indian Institute of Science) had spent a year as a Guest Investigator in his laboratory (1962–63), after becoming the first Professor and Head, Department of Zoology, University of Delhi.

William Trager, the son of Leon and Anna, was born on 20 March 1910 in Newark, New Jersey. His parents encouraged scholarly and intellectual pursuits. The caterpillars he collected as a child sometimes hatched out parasitic flies instead of butterflies. 'Another collector would have been disappointed, but I was fascinated', he used to recall. He liked parasites more than most people do. The walls of his Manhattan apartment were also decorated with nicely framed mounts of large colourful butterflies, perhaps reminding him of his early days.

Trager obtained his B S degree from Rutgers University in 1930 and Ph D degree from Harvard University in 1933. His doctoral work was on symbiotic flagellates of termite under the supervision of L. R. Cleveland. In 1933, at the young age of 23, Trager entered postdoctoral training under R. W. Glaser, as a Fellow of National Research Council, at the Department of Animal Pathology, Rockefeller Institute, Princeton, New Jersey. His early years were thus spent in studying insect physiology and pathology, which laid the foundation for his subsequent innovative achievements. In 1934, he was appointed to the staff of the Rockefeller Institute (which became the Rockefeller University in 1953), that remained his home for scientific endeavours for the rest of his life.

Trager married his high-school acquaintance Ida Sosnow in 1935. They infused love of life and good norms of civil society in their children: two daughters and a son. All three of them are well-established, reputed persons in their respective domains. As is often the case, when one of a couple dies, that had lived together for long, the other follows. It was to be the same with Trager; Ida had passed away about a year before.

Trager's research contribution to the field of animal parasitism had been enormous. One thing that stood out was his skilled and gifted mastery of laboratory culture techniques. He studied the nutritional needs of mosquito larvae *Aedes aegypti*, the yellow-fever vector. In an era before antibiotics, he was the first one to set up a germ-free culture system for mosquito larvae[2]. He later extended his work to develop culture methods for silkworm and mosquito tissues. These new methods

of insect tissue culture had subsequently been employed by numerous investigators for propagation of polyhedral virus in silkworm tissues and Western equine encephalitis in mosquito tissue, thus opening new vistas on studies *in vitro*. It was in early 1970s that he developed a method for cultivating one of the principal agents of cattle trypanosomiasis, *Trypanosoma vivax* in the cultured cells of tsetse fly. The cattle trypanosomiasis decimates food herds in Africa. These exceptionally creative research contributions of Trager got him elected to the National Academy of Sciences, USA in 1973.

Trager's interest to minimize the adverse economic impact of ectoparasites on livestock production prompted him to investigate ticks. These obligate parasites infest mammals, birds, reptiles and amphibians, and are the most significant vectors of animal diseases, second only to mosquitoes in the number of human diseases they transmit. He had demonstrated acquired immunity in vertebrates to Ixodid ticks[3]. Hence, immunization to ticks could be of material value in protection against tick-transmitted diseases of cattle.

Trager's work with insect tissue culture helped establish the general principle that insects require the same growth factors of vitamin B complex as vertebrates do, and provided the first direct evidence of the significance of nutritional factors in the host's susceptibility to malaria. He had shown that intracellular parasites lack certain biosynthetic pathways, and depended on their host cells for cofactors essential to their own metabolism. Trager's interest in malaria parasites was deep-rooted. After World War II, it was assumed that DDT spray would eradicate malaria mosquitoes. In India, for instance, malaria cases dropped from 100 million in 1952 to 60,000 in 1962. However, malaria eradication programmes failed to achieve their targets globally. Spraying became less effective and more expensive. Mosquitoes acquired resistance to DDT and cases of malaria infection not responding to chloroquine treatment started appearing. Malaria was on resurgence mode. Prospects of malaria vaccine development were being actively discussed. Natural malaria infection does not provide long-term immunity to the host. However, there existed the possibility to induce longer duration immunity, if the host was to be challenged with more concentrated amounts of antigenic material than ordinarily produced in malaria infection. Large amounts of parasite material were needed for this. Those were the days prior to the advent of recombinant DNA technology. In early 1970s Trager turned his attention to cultivation of *Plasmodium falciparum.* A historic breakthrough in parasitology research was published[4] in 1976, wherein William Trager and James Jansen reported the conditions conducive for continued *in vitro* cultivation of erythrocytic stages of killer human malaria parasite, *P. falciparum.* This ground-breaking discovery was acclaimed globally, more so in the tropical world. Harvard researchers considered it akin to cultivation of polio virus years ago in tissue culture – ultimately leading to the development of polio vaccine. Malaria vaccine still eludes us, but this cultivation method had brought human parasites into the laboratory really for the first time. It has turned out to be the most efficient and economical tool for screening new antimalarial drugs, and had provided the much needed impetus to understanding the mechanisms of drug action. Trager

had even achieved complete extracellular cycle of *P. falciparum* development *in vitro*.

Trager was the first editor of *The Journal of Protozoology* (1953–65), President of the Society of Protozoologist (1960–61), President of the American Society of Parasitologists (1973–74), President of the Fifth International Congress of Protozoology (1977) and President of the American Society of Tropical Medicine and Hygiene (1978–79). He had served in an advisory capacity for the World Health Organization (WHO), and the National Institute of Allergy and Infectious Diseases, USA. He was made Professor Emeritus at the Rockefeller University in 1980.

Trager authored two books entitled *Symbiosis* (1970) and *Living Together – The Biology of Animal Parasitism* (1986). His list of scientific publications runs to over 200 papers. His distinguished career earned him numerous honours. He was selected as a Guggenheim Foundation Fellow (1973–74), conferred with the Doctor of Science degree by Rutgers University (1965), and the Rockefeller University (1987). He was awarded the Fifteenth S. T. Darling Medal and Award in Malariology by WHO (1980), the Leuckart Medal by the Deutsche Gesellschaft fur Parasitologie (1982), the Manson Medal by the Royal Society of Tropical Medicine and Hygiene (1986), the Augustine Le Prince Medal by the American Society for Tropical Medicine and Hygiene (1991), and the Prince Mahidol Award in Medical Science in Bangkok, Thailand (1994–95). The Society of Protozoologists, instituted in 1998, the William Trager Award for Outstanding Paper of the Year, for each calendar year, for his leadership role in establishing *The Journal of Protozoology* (now *Journal of Eukaryotic Microbiology*).

Trager was always an avid investigator of parasites, with an innate art of parasite cultivation. The twin attributes tricked killer parasites (*P. falciparum*) to submit to domestication. He inspired a generation of researchers, many of whom are now well-known leaders in animal parasitism and various fields of biosciences. He was an honest and humble mentor to many and mattered a lot to each one of them. He was active, going thrice a week to his office at the Rockefeller University, until a few weeks before his end. The void created by his demise will take time to fill.

One of us (S.S.), during postdoctoral tenure at the Department of Biochemistry, New York University Medical Center, had the fortune of frequently meeting and discussing work on the malarial circumsporozoite gene/protein[5,6] with him at the Rockefeller University. In a gentle and subtle way, he would caution not to lose sight of the parasite and host cells in our pursuit of the gene/protein structures. Trager had the ability to blend his cumulative diverse expertise of traditional knowledge with research in modern biology with remarkable foresight. He continued to take active interest in malaria work of S.S. even after her return to Mumbai, and would at times advise her with his enormous insight regarding host–parasite interactions. He was generous in sharing his strains and reagents. Trager was a voracious reader of malaria literature.

Trager travelled to Mumbai along with Ida to receive the First Rameswardas Birla International Award in Tropical Medicine in 1982. They visited various academic and research institutes in Bangalore, Delhi and Lucknow. It was an honour and a privilege for V.K.B. to have worked for about three years in Trager's Laboratory of Parasitology, and above all, to know him and Ida. Trager was a gifted and inspiring scientist and one of the most decent human beings one came across. Although his pioneering work on malaria will remain immortal, Trager will be missed dearly.

1. Shakuntala, K. and Parthasarthy, M. D., *Curr. Sci*., 1994, **67**, 60.
2. Trager, W., *J. Exp. Biol*., 1937, **141**, 240.
3. Trager, W., *J. Parasitol*., 1939, **25**, 57–81.
4. Trager, W. and Jensen, J. B., *Science*, 1976, **193**, 673–675.
5. Godson, G. N., Ellis, J., Svec, P., Schlesinger, D. H. and Nussenzweig, V., *Nature*, 1983, **305**, 29–33.
6. Sharma, S., Svec, P., Mitchell, G. H. and Godson, G. N., *Science*, 1985, **229**, 779–782.

V. K. BHASIN[1,*]
SULABHA PATHAK[2]
SHOBHONA SHARMA[2]

[1]*Department of Zoology,*
University of Delhi,
Delhi 110 007, India
[2]*Department of Biological Sciences,*
Tata Institute of Fundamental Research,
Homi Bhabha Road,
Mumbai 400 005, India
**e-mail: virendrabhasin@hotmail.com*

Edited and published by P. Balaram, Current Science Association, Bangalore 560 080.
Typeset by WINTECS Typesetters (Ph: 2332 7311), Bangalore 560 021 and Printed at Printek Printers, Bangalore (Ph: 2328 7763)