

A visionary and courageous scientist

An obituary of Jonas Salk

Jonas Edward Salk, a visionary and courageous scientist who invented the first vaccine to protect children (and adults) against the crippling disease poliomyelitis, passed away in La Jolla on 23 June at the ripe age of 80. His contributions are monumental and in countries continuously using the Salk vaccine the result was an initial drastic reduction in the incidence of the disease and, thereafter, total eradication of polio. He was also a builder of institutions and had to his credit the founding of the well-known Salk Institute for Biological Research.

His incursions in vaccinology began in 1942 at the University of Michigan, where he helped develop a commercial vaccine against the influenza virus. Several thousand soldiers in the US Army were immunized with this vaccine employing a potent immunopotentiator similar to Freund's incomplete adjuvant. A follow-up of these subjects 25 years later did not indicate any incidence of cancer or abnormality attributable to this immunization. Based on these observations he questioned the wisdom of not using such adjuvants for obtaining high and long-duration response with vaccines destined for human use. Before his death, he was deeply involved in making a vaccine against HIV in which he was intending to use this adjuvant.

In 1947, Jonas Salk moved to Pittsburgh in a faculty position as the Head of the Virus Laboratory. It is here that he started work on the polio vaccine, which received impetus from President Roosevelt, who had himself been a victim of polio. His researches were generously funded by public and private funds, prominent amongst which was a grant of \$7.5 million from the March of Dimes campaign launched by the National Foundation for Infantile Paralysis. In an amazingly short period of 8 years, in a promotional climate free from obstructions, his vaccine passed from laboratory to human trials. The results of the large-scale trial announced in 1955 were impressive. The vaccine conferred 80–90% protection. Imbued with humanitarian concern, he did not patent the vaccine nor made money from it. It was licensed to six companies on

easy terms for large-scale availability to the public. By 1960, the incidence of polio declined by 92% in the United States. President Eisenhower awarded him the Congressional Medal for Distinguished Civilian Achievement. It was taken up for immunization of children in other countries with equally impressive protection rates and fall in incidence of the disease. The French Govt. conferred on him the Legion d'Honneur for his work of international significance.

Then came a setback for no apparent fault of Salk. One of the batches of the vaccine manufactured by a company failed to kill the virus completely and the vaccine caused unforeseen deaths of about 300 recipients. The government imposed a ban on this vaccine in USA, even though it continued to be in use in Canada, Holland, Scandinavia and some other European countries. Meanwhile, a rival vaccine developed by Albert Sabin became available and was introduced in USA in 1961 based on trials conducted in USSR. The Sabin vaccine consisted of three strains of live *attenuated* polio viruses, in contrast to the Salk vaccine, which employed *killed* viruses. The Sabin vaccine had the ease of oral administration, whereas the Salk vaccine required to be injected. The counterpoints were that the Sabin vaccine demanded to be kept frozen to remain active, whereas the Salk vaccine did not require the 'cold chain'. The mode of action of the two

vaccines was also somewhat different. The Salk vaccine, by systemic immunization, generated antibodies and cytotoxic cells, inactivating and killing the infecting polio virus. No live virus was released in the stools. The Sabin vaccine sought to induce local immunity in the gastrointestinal tract against the infectious virus. The live attenuated polio viruses present in the vaccine, however, colonized in the gut and were released to the environment in faeces. It was conceived that these viruses would be taken by others in the community and would hence create 'herd' immunity over and above the individuals immunized.

On face value, the Sabin vaccine was cheaper and appeared to be more suitable for general immunization programmes in children. However, trials conducted by Dr S. Bhallaya at the All India Institute of Medical Sciences, New Delhi, and by Dr Jacob John at the Christian Medical College, Vellore, showed the superiority of the Salk vaccine for inducing antibodies against the polio viruses as compared to three doses of the Sabin vaccine given orally. Similar results were reported from Algeria. The relative poor immunogenicity of the Sabin vaccine was not ascribable to the improperly frozen vaccine in the above-mentioned trials conducted by experienced virologists. It is surmised that five doses of the oral vaccine may be necessary for satisfactory sero-conversion of the children.



Jonas Salk (right) with the author at the 5th International Congress of Immunopharmacology at Tampa, Florida (1991)

This does pose practical difficulties of repeat visits and compliance in the expanded programmes of immunization. These difficulties are further compounded by the uncertainties of availability and maintenance of cold chain for this vaccine in far-flung rural areas. Thus, after due scrutiny of the data, the Indian Council of Medical Research recommended the use of the Salk vaccine as such or as adjunct to the Sabin vaccine. An opportunity to make the Salk vaccine in the country, along with two other cell-culture-derived vaccines against measles and rabies, came forth in 1989 with the French company Merieux agreeing to be a partner in a venture along with the Department of Biotechnology, Indian Petrochemicals, and 25% shares accessible to public for investment. Jonas Salk (and others including me) played an active rôle in motivating Merieux to come to India with a technology that will be useful for more than one vaccine of proven efficacy. An agreement was signed in New Delhi by the President of Merieux with counterpart officials in the august presence of President François Mitterand and Prime Minister Rajiv Gandhi. Had this agreement

materialized, India would have been the largest producer of these vaccines in the world, meeting its own needs and exporting to other countries. Merieux had a further proposal of making a quadruple vaccine comprised of DPT (diphtheria, pertussis and tetanus) along with the Salk polio vaccine. Thus, complete immunization of the child against these four killer diseases could be accomplished with a common vaccine. A cherished goal of researchers and public health organizations is to have a vaccine with multiple components to prevent all childhood infections by a single intervention. Technologies are evolving to deliver multiple doses of the vaccine in biodegradable microspheres at a single contact point.

Jonas Salk was a pioneer vaccinologist. He was also a thinker and theorized on the implications of scientific findings on man and his place in society. He authored four books in this context: *Man Unfolding* (1972); *The Survival of the Wisest* (1973); *World Population and Human Values* (1981) and *Anatomy of Reality* (1983). He rallied readily for public causes. In spite of specialized focusing that any notable scientific work demands, his out-

look was broad. He had a sensitive personality, and was at home amongst writers, artists and thinkers. He married in 1970 an equally lovable person, Françoise Gilot, an artist and a writer (*My Years with Picasso*) who was for many years a companion of and lived with Pablo Picasso. He is survived by three sons from his first wife.

Although Jonas Salk did not get the Nobel prize, he received several recognitions. In 1975, he delivered in New Delhi the Jawaharlal Nehru Award Oration for International Understanding.

In response to the havoc that AIDS was causing worldwide, he got energized in the last years of his life to make a vaccine against this 'clever' virus, which attacks and incapacitates the host immune status. With his demise, his ambition remains unfulfilled.

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A doyen of Indian physicists

An obituary of S. D. Chatterjee

Professor Shyamadas Chatterjee, a doyen of Indian physicists, passed away in Calcutta on 27 May 1995 at the age of 86.

Born on 29 June 1909, he studied at Cuttack, Patna and then at Presidency College, Calcutta, obtaining his B Sc degree in 1930 and M Sc degree in Physics from Calcutta University in 1932. Among his teachers was none other than C. V. Raman, who on winning the Nobel Prize in 1930 graciously acknowledged the letter of congratulation from his young student. Chatterjee joined the Bose Institute, founded by the pioneer Jagadish Chandra Bose in 1938, and showed his experimental skills by constructing one of the first Wilson cloud chambers in India. For his

research on cosmic rays he was awarded the D Sc degree of Calcutta University in 1945, his examiners being Blackett and Cockroft.

When the news of the discovery of nuclear fission reached India, he set up his own experiment with indigenous components to detect the emitted neutrons. He was thus the first one to detect the spontaneous fission of uranium in 1940. For the interpretation of his experimental results he was indebted to S. N. Bose. His brief communication to *Science and Culture* was, however, withdrawn as it had been sent without the permission of the then Director of the Bose Institute! His estimate of the half-life of uranium was a few orders of magnitude less than

the value of Teller but was verified by Georgy Flerov from the Soviet Union within a few months. The actual calculation of the half-life from the detector counts was done by N. R. Sen of the Department of Applied Mathematics. In return Chatterjee repaired Sen's radio set, an indication of how scientific collaboration worked in those days! Chatterjee was awarded the Woodburn Medal of Calcutta University for best research in 1948 and the Elliott Medal of the Royal Asiatic Society in 1951.

In 1949 Chatterjee went to Chalk River, Canada, and also visited several laboratories in the USA, including the National Bureau of Standards, where he interacted with Tuve. He maintained contact with